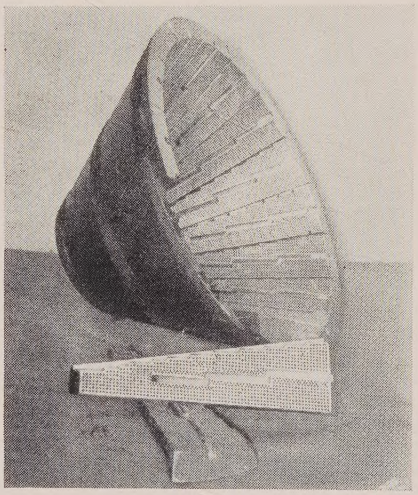
Tappi

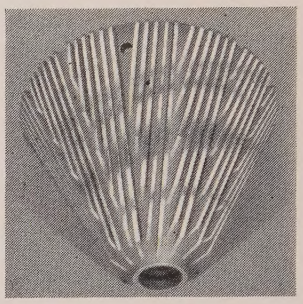
PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

FEBRUARY 1949

THE HERMANN CLAFLIN REFINER

"WITH"





BRUSHING-HYDRATING FILLING

"FOR"

CONTINUOUS STOCK PREPARATION

This type filling is producing very satisfactory results with low power per ton for the amount of work accomplished in place of beaters and all jordans in helping prepare Kraft Pulps for grades requiring maximum strengths including cement bag, gumming, waxing, envelope, bond, bag and specialties.

Equally suitable for Sulphite grades with mixed furnish of Sulphite and Kraft, Soda Pulp, Groundwood, Cotton Linters and Deinked Stock.

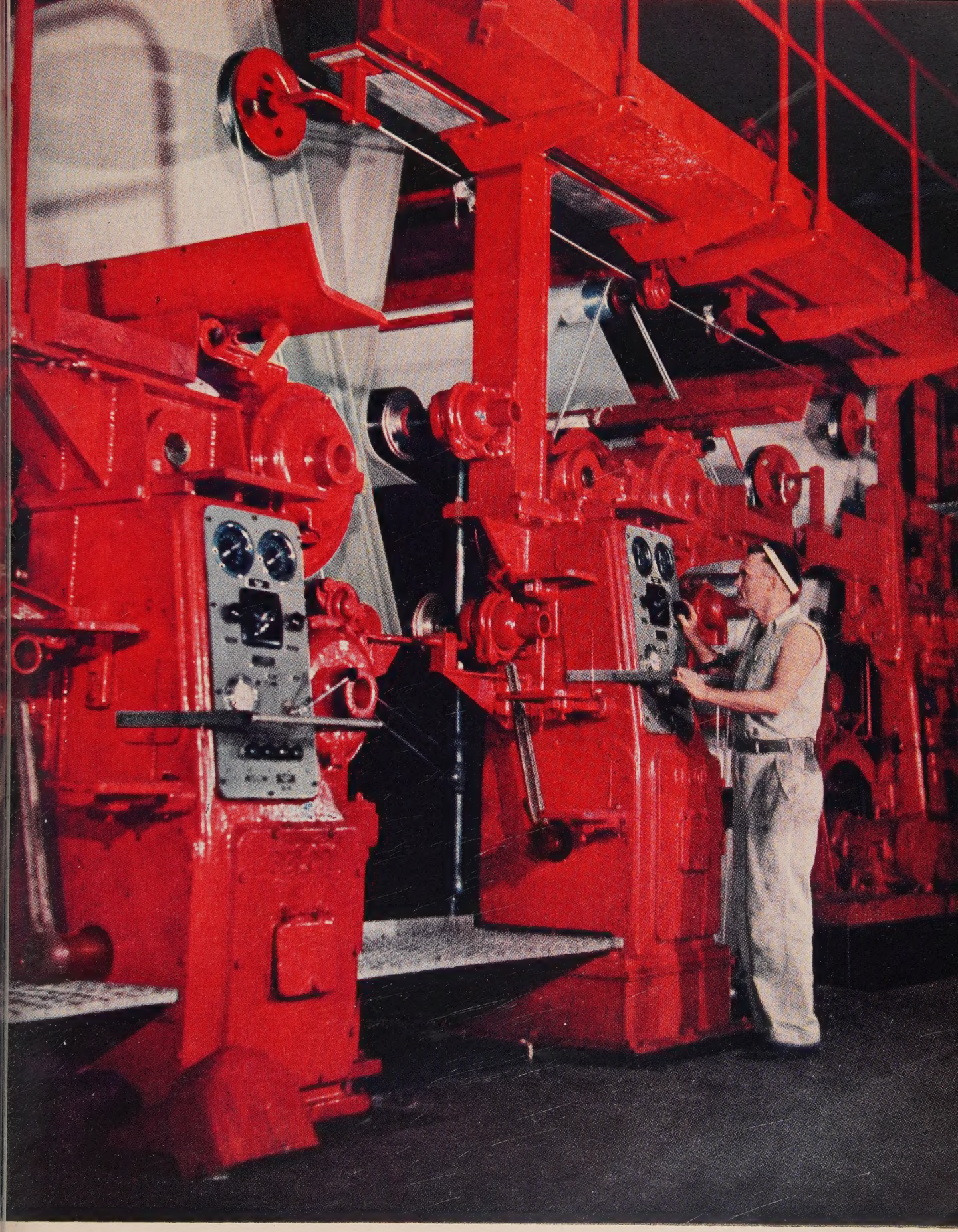
Also used by Board Mills for top liner with furnish of pulp and kraft cuttings or 100% kraft waste. Corrugated and mixed paper for filler brushed out with a minimum of cutting and fibre loss.

Two hundred units with various types of fillings are in operation in mills in Alabama, Arkansas, Illinois, Louisiana, Michigan, Minnesota, Mississippi, New Jersey, Ohio, Tennessee, Texas, Wisconsin, and other states, including Canada.

THE HERMANN MANUFACTURING CO.

Also: TAPPI Standard Pulp Testing-Sheet Making Apparatus

LANCASTER, OHIO

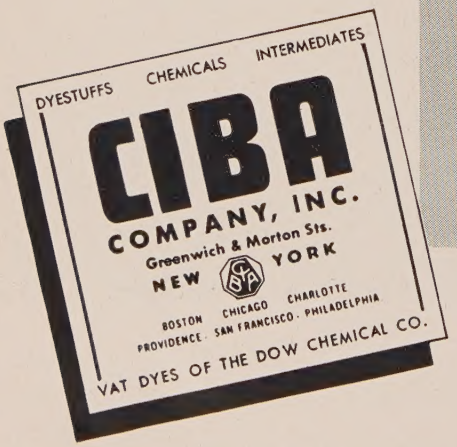


"RIPCO MAID" . . . Rhinelander's huge new Beloit Fourdrinier machine for making glassine and grease-proof papers is seen above. Rhinelander Paper Co. blazed a trail with the "Big Swede" in 1941 and now takes another long stride forward with the ultra-modern "Ripco Maid." As designer and builder of these two machines, Beloit Iron Works knows their capabilities, and extends congratulations to the management and entire staff at Rhinelander for notable leadership and outstanding paper production.—*Beloit Iron Works, Beloit, Wisconsin.*

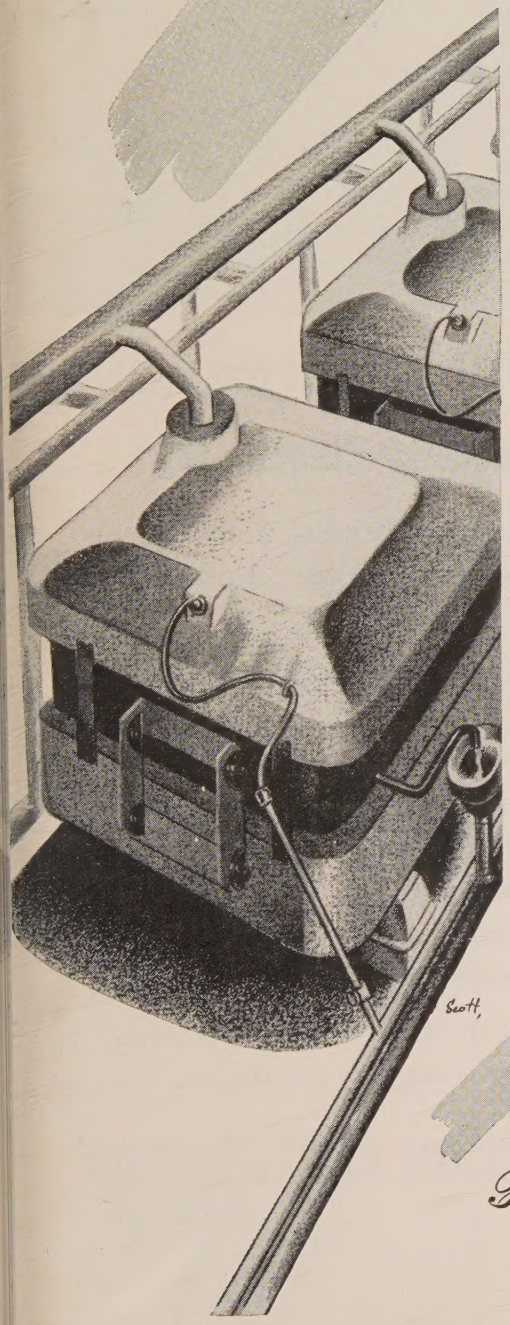
the proof's on PAPER

with CIBA DYESTUFFS

- for beater. . .
- calender. . .
- coating processes



How Hooker cell research helped bring bleaching costs down



THE WRIGHT BROTHERS had just proved that a heavier than air machine could sustain itself in flight, when a group of men with foresight along different lines, organized to explore the possibilities of a new patent. The object of this patent, the Townsend cell, was a new type of electrolytic, diaphragm cell. In exhaustive tests it substantiated the claims made for it in producing chlorine by passing direct current through a brine solution.

In 1906, just three years later, the Hooker Electrochemical Company was in operation at Niagara Falls close to an unfailing source of hydro-electric power, and ready to supply its chief product, bleaching powder, to the pulp and paper industry.

Hooker chemical engineers have kept up continuous research and experimentation to improve Hooker cell efficiency and bring costs down. In 1913 the Hooker "F" cell gave way to the "E" cell. Later improvements are found in the present Hooker type "S" cell of radically new design. This cell is highly efficient as to power and economical as to cost of installation, maintenance, and operation—all of which means uniform quality chlorine and caustic to you at a reasonable price. Because of these improvements in cell design and other manufacturing economies, the price of chlorine has been brought down from $120.00 a ton in 1921 to approximately $40.00 a ton today.

Coincident with these developments, Hooker Technicians were working with pulp and paper making chemists; suggesting new bleaching techniques, conducting experiments and tests to learn the why and the how of pulp and paper processes. Their findings are available in Bulletin form reprinted by the Hooker Electrochemical Company. They cover subjects of interest to everyone in the pulp and paper field. Those of you who have recently become associated with this industry will find them of especial profit. Send for a list of the currently available Hooker Bulletins.

HOOKER ELECTROCHEMICAL COMPANY
4704 BUFFALO AVE. NIAGARA FALLS, N. Y.

New York, N. Y. Wilmington, Calif. Tacoma, Wash.

From the salt of the earth

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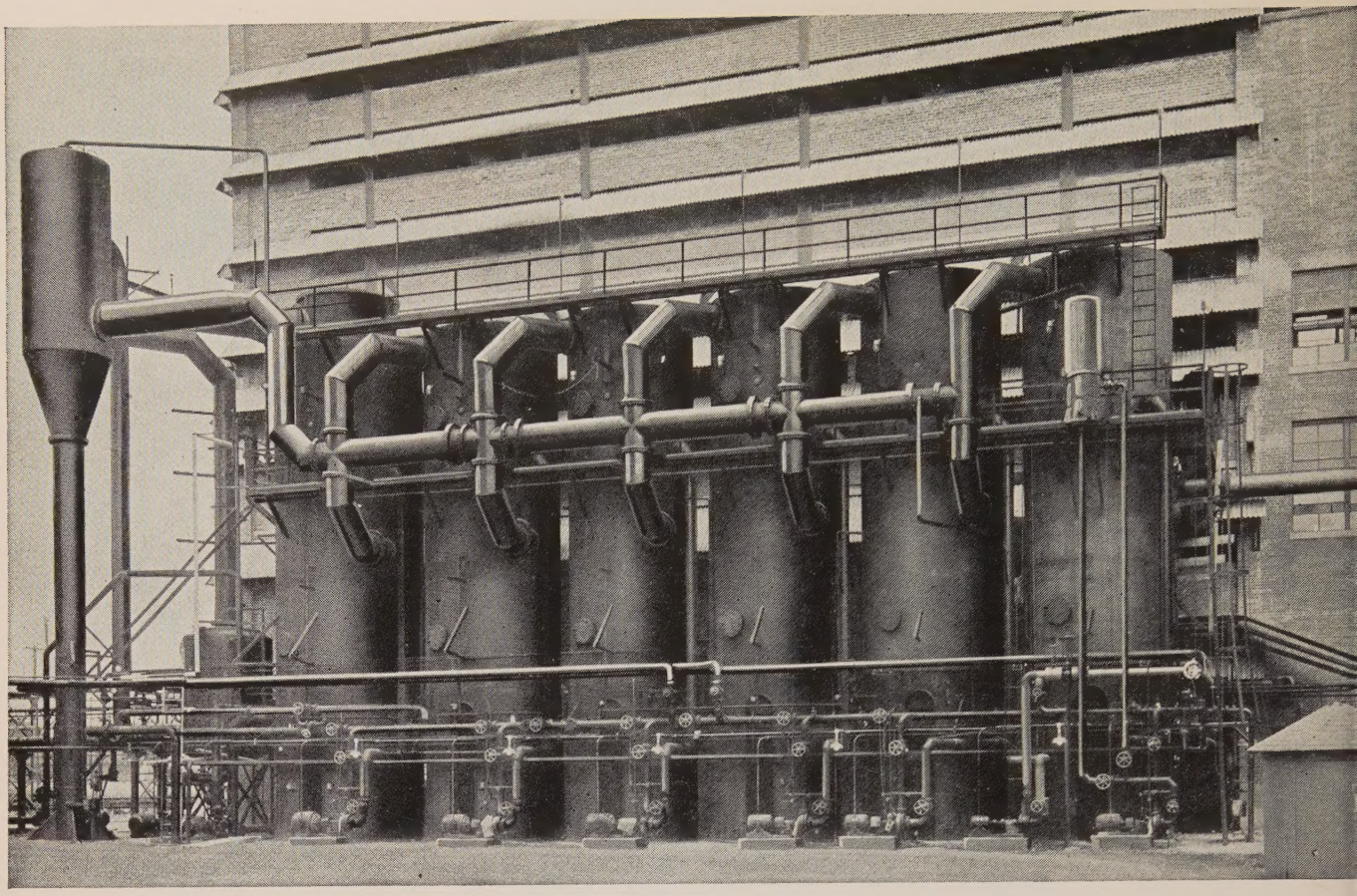
Caustic Soda Muriatic Acid Sodium Sulfide Paradichlorobenzene Chlorine Sodium Sulfhydrate



One of the largest SINGLE EVAPORATOR INSTALLATIONS in the U.S. is at the new plant of the SOUTHERN PAPERBOARD CORPORATION

Containing 63,000 sq. ft. of heating surface, this unit—a Conkey Self-Supporting Sextuple Effect Long Tube Film Type Evaporator—is concentrating black liquor.

The Conkey Self-Supporting Type was chosen because of the following features—

- Low installed cost.
- Greater capacity per square foot of surface.
- Lower pressure drop between effects.
- Simplicity of operation.
- Goes on the line quickly.
- Reduces overall down-time.

Other large Conkey Self-Supporting Type Evaporators are installed in leading pulp mills on this continent.

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FEBRUARY 1949

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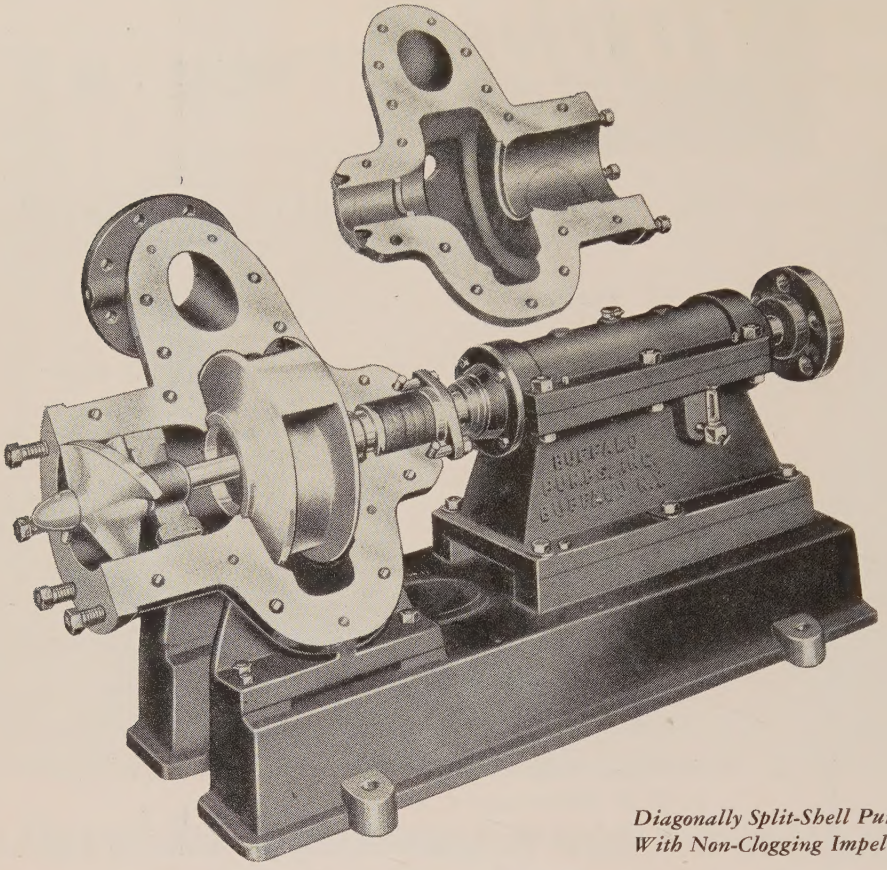
PUMPS by "Buffalo"



Diagonally Split-Shell Pump With Non-Clogging Impeller

Put your STOCK PUMPING

on this "ANTI-TROUBLE" basis!—with the "Buffalo" Pump made for your job!

There's no economy in a pump that needs continual attention and repairs! Likewise, the wrong *type* of pump for a specialized stock job just isn't going to give you the *performance* you paid for. By choosing the "Buffalo" line of paper pumps, you're sure of avoiding these two troubles. "Buffalo" engineers designed these pumps—tested, redesigned and retested them—on the basis of WHAT PAPER MILL MEN WANTED. The result of this close-contact with on-the-job paper needs has been a *group* of pumps, all highly specialized. Thus, pumps for "high head" jobs—pumps for high consistency stocks—pumps for "lumpy" liquids, and so on—all non-clogging, all designed for the best possible service on special jobs. As hundreds of other paper mills have done, you can pick the RIGHT pump from the complete "Buffalo" line—a pump that will "go the distance" for you, without those costly repair stops. It's worth investigating! Write for Bulletin 953-F or contact your "Buffalo" representative, and get the full story!

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★ WATER, ANY TEMPERATURE

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★ SUMP CLEARANCE

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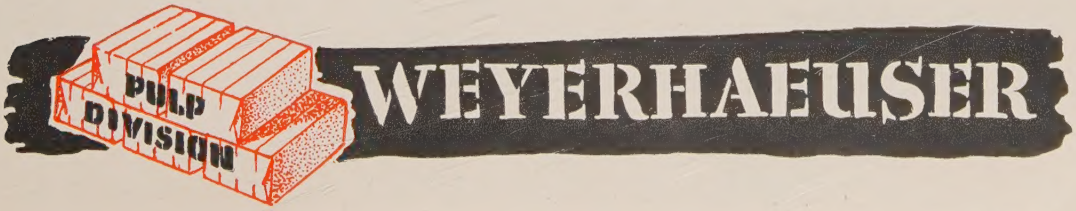
RUGGED, PRECISION CONSTRUCTION—FOR LONG LIFE

Fire is Forest Enemy No. 1. In most years more trees are destroyed by fire than are harvested! And the pity of it all is that most fires are caused by human carelessness and ignorance of the far-reaching consequences. Nine out of ten fires can be traced to man. Careless smokers *alone* cause one out of four.

The men and management of Weyerhaeuser Timber Company are keenly alive to the necessity of protecting forest lands from fire. Since 1903 the Weyerhaeuser organization has been participating in cooperative fire protection efforts with other private forest owners and with State and Federal agencies.

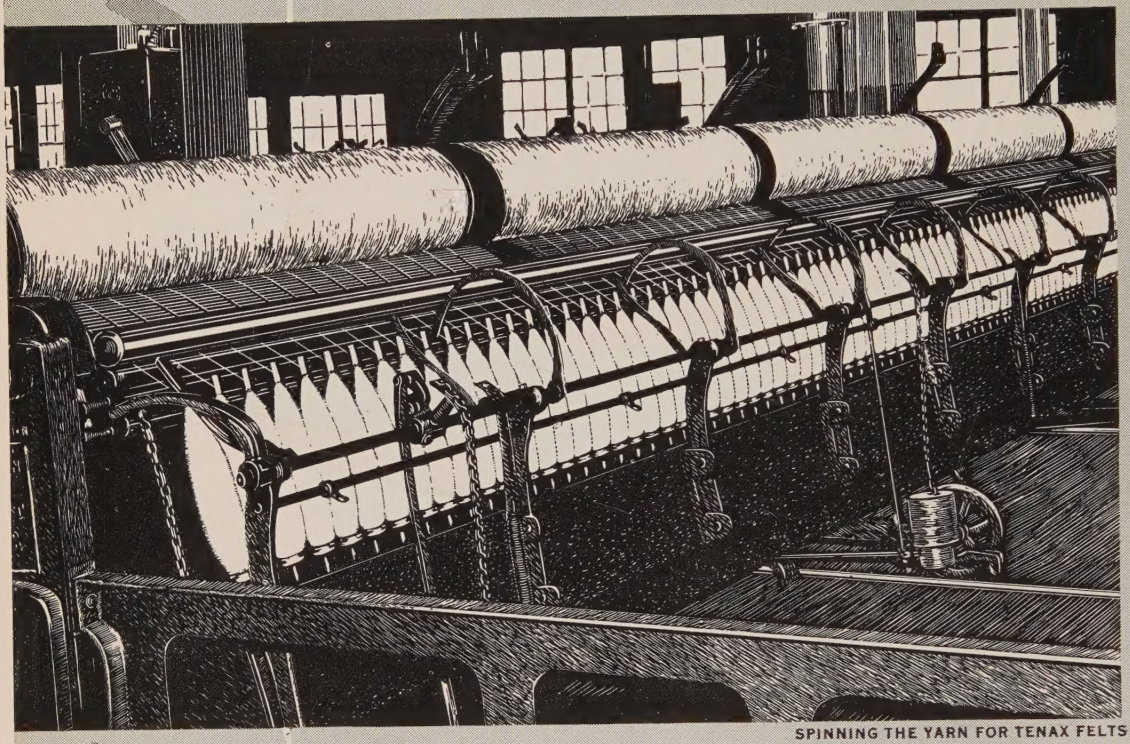
Supplementing its fire protection activities, the Weyerhaeuser forestry management program also includes relentless insect and disease control throughout its extensive timber tracts and the company's eight thriving Tree Farms which are producing harvests for the future.

Furthered by this constructive forestry policy, the Pulp Division represents a reliable and continuing source of supply for consumers of bleached chemical woodpulp.



TENAX FELTS

—better felts—enabling you to make better paper

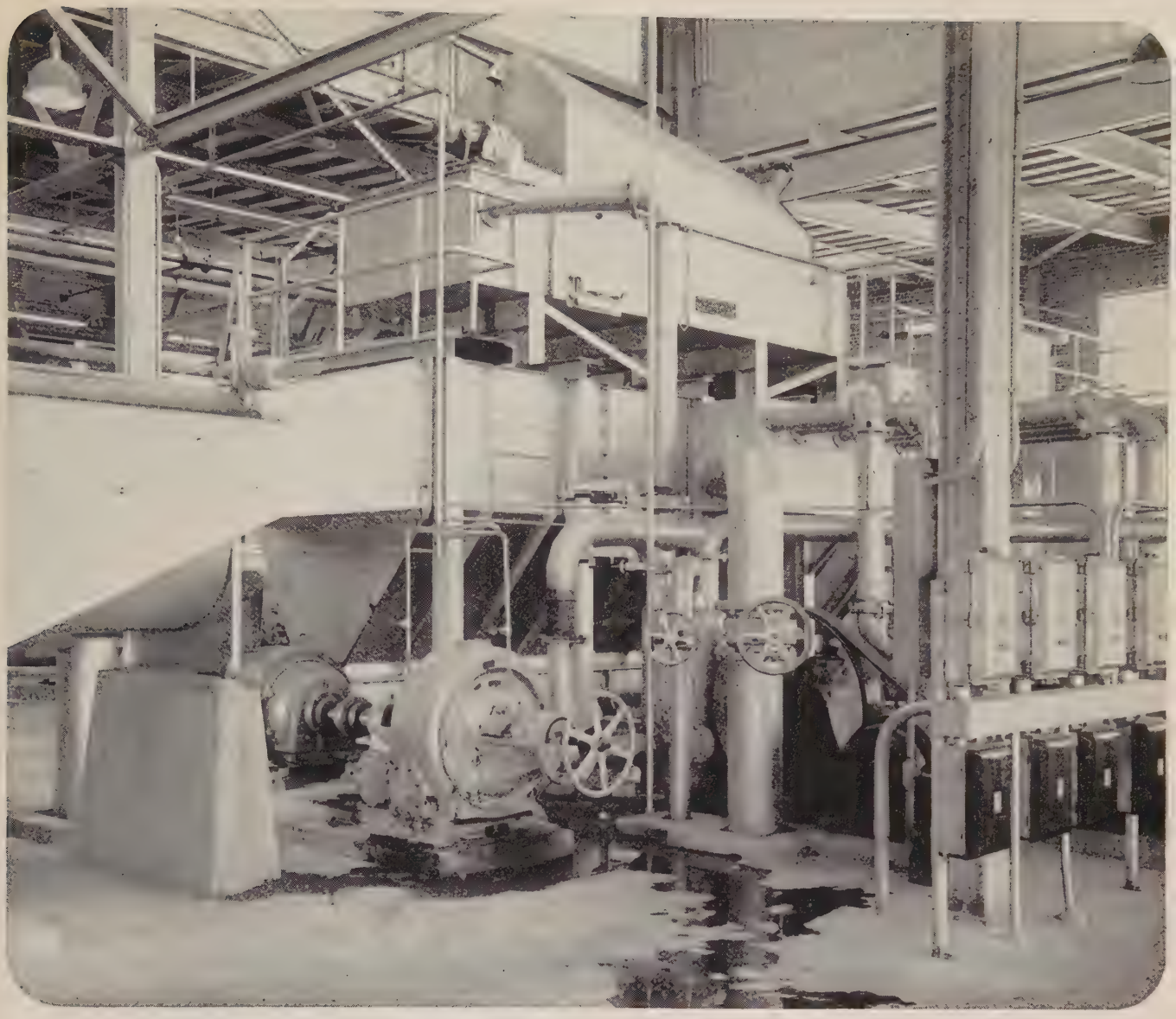


SPINNING THE YARN FOR TENAX FELTS

Modern, efficient machinery—and the craftsmanship and skill of long experience combine at the Lockport Mills to bring you the finest felts for making the finest paper.

The Lockport representative in your territory is fully qualified to advise on all technical questions relating to felts. He is at your service as is our plant and all its people. We invite your inquiries.

LOCKPORT FELT COMPANY · NEWFANE, NEW YORK



STOCK-CLEANING FOR FILLER IN MODERN BOARD MILL

The Shartle-Dilts grit-remover system here shown is surprisingly compact—occupies just about the same amount of floor space several Holland beaters would require — yet cleans enough dirty mixed paper to produce 350 tons of filler for board.

Ahead of it three 85-foot conveyors deliver to three Hydrapulpers and following it is a Shartle-Dilts "controlled-refining" system made up of 3 HYDRAFINERS and 6 Miami Jordans.

Anyone contemplating the erection of a new board mill, or the improvement of a board mill already in service, should obtain complete data on this interesting layout for detailed study and consideration.

Address Shartle or Dilts.

Shartle Bros. Machine Co., Middletown, Ohio
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Divisions of THE BLACK-CLAWSON COMPANY, *Hamilton, Ohio*
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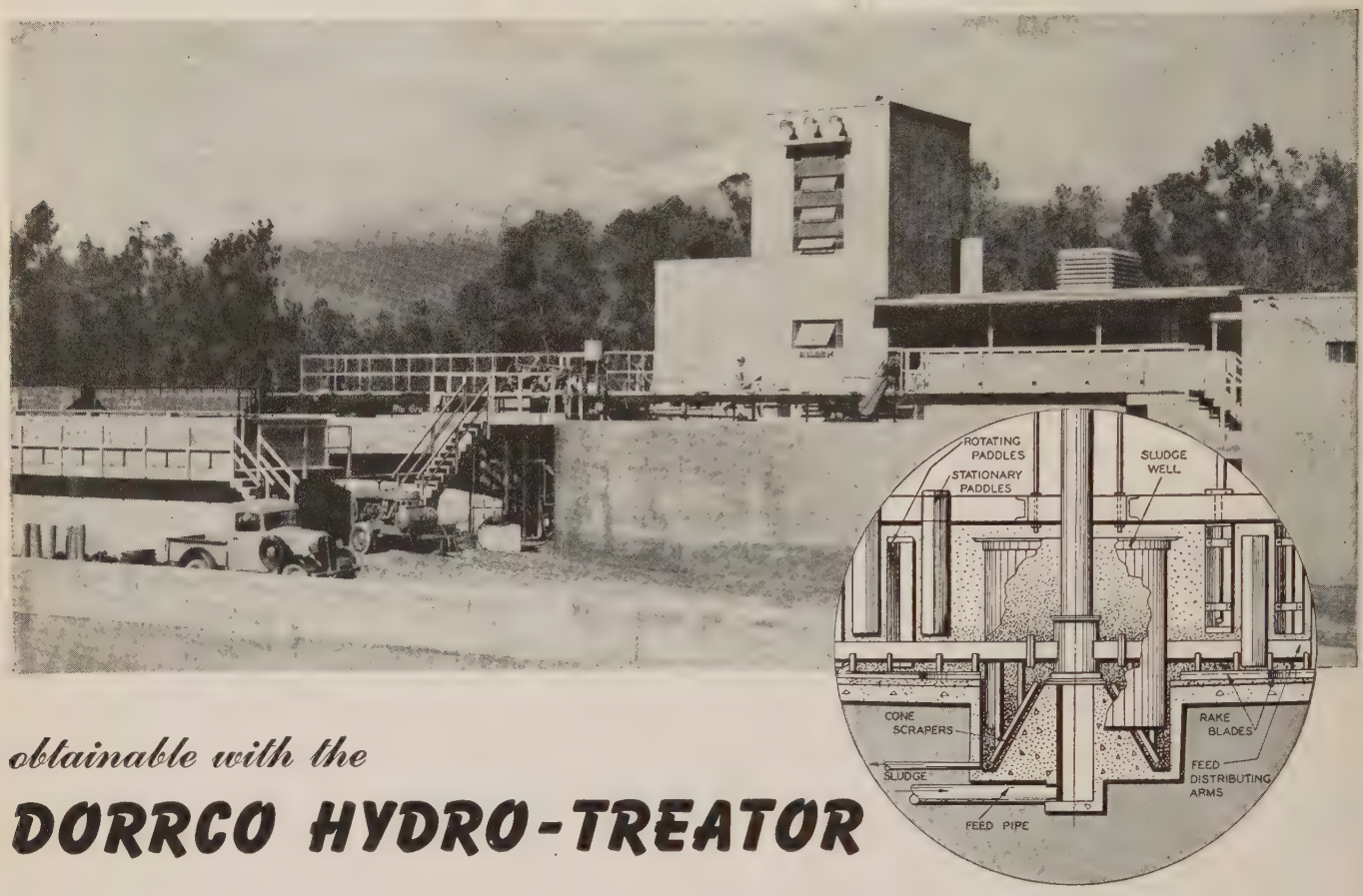
A must for successful water treatment . . .

POSITIVE SLUDGE REMOVAL



obtainable with the

DORRCO HYDRO-TREATOR

Positive mechanical removal of settled solids . . . an essential of high rate water treatment . . . is assured by Dorrco Hydro-Treator design.

HERE'S HOW IT WORKS

As feed is distributed, heavy, gritty solids quickly settle to the floor of the Flocculation compartment and are raked inward to the central discharge cone. Light, flocculated solids drift into the sludge well, and are thickened by the picket scrapers as they settle to the discharge cone. *In both cases, rake and scraper action is positive . . . forcing all solids to one central point for discharge.*

EFFECTIVE TREATMENT

Softening, color or turbidity removal can be *effectively* accomplished in the Hydro-Treator because of such features as uniform feed distribution, uniform flocculation conditions and zoned sludged thickening.

LOW INSTALLATION AND OPERATING COSTS

First cost is held to a minimum by simplicity of Hydro-Treator tank and mechanism design. *Treatment cost* is low because Hydro-Treator mechanism design promotes fast chemical reaction without interference among the three treatment zones.

FOR FURTHER INFORMATION

Dorrco Hydro-Treators are available in sizes ranging from 10 ft. to 100 ft. in diameter. A Dorr engineer will gladly supply more detailed information.

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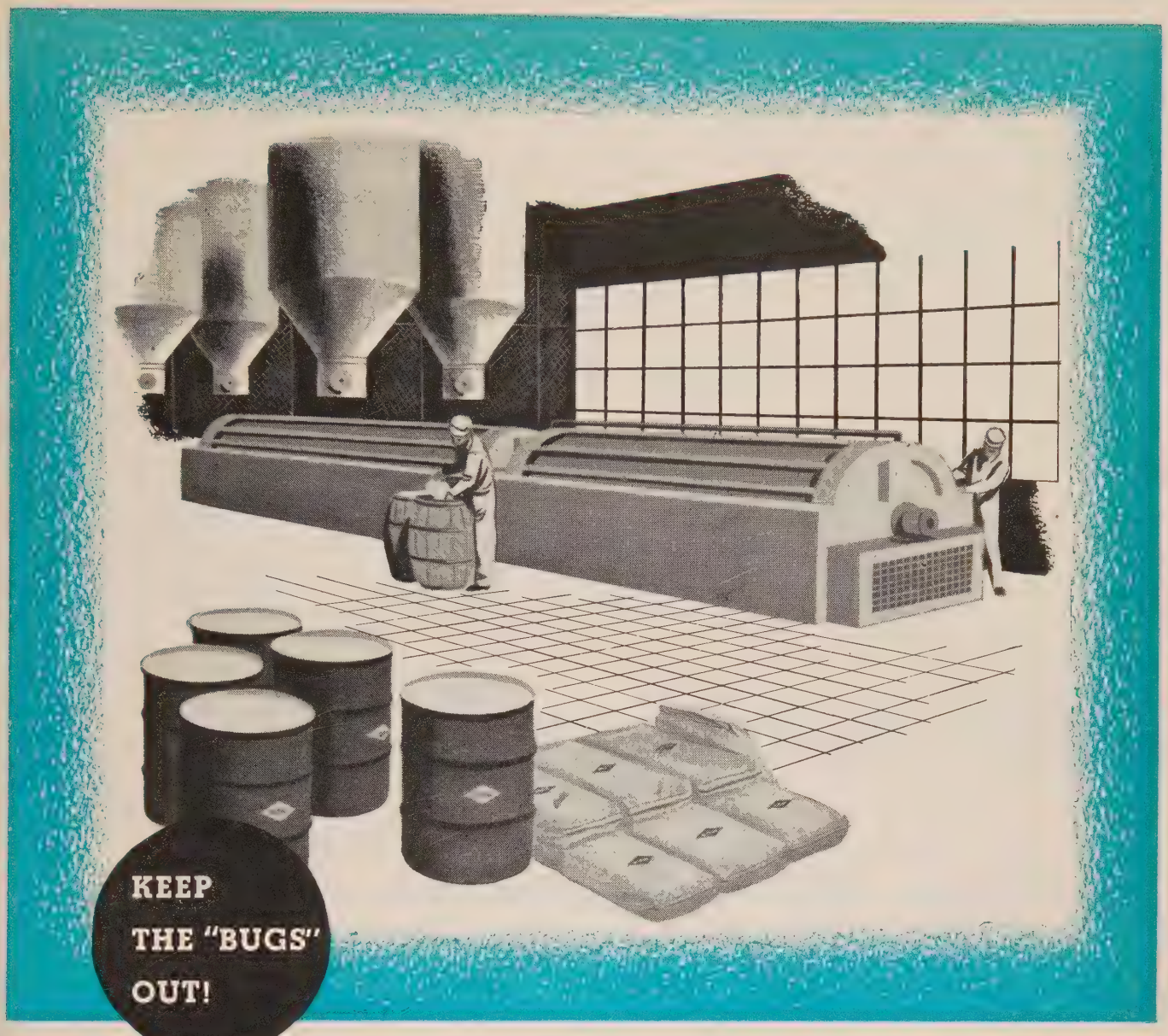

Dowicides control waste!

Bacteria and fungi control is especially valuable in the pulp and paper industries, where manufacturing and storage conditions foster the growth of destructive microorganisms. In this field, as in nearly every other major industry today, the Dowicides serve in every phase of operations from logs to finished product.

Of top importance is the fact that starches, casein, glue and other decomposable adhesives can be made mold-resistant with the Dowicides. Costly losses from mildew on lap stock in storage, from deterioration of paperboard cartons in humid warehouses, and from the destructive action of bacteria and fungi on machine felt can be markedly reduced by using the Dowicides in processing oils and emulsions.

If mold and bacteria are causing *you* trouble, let us know. We welcome the opportunity to discuss your problem with you. Write or phone the nearest Dow Sales Office.

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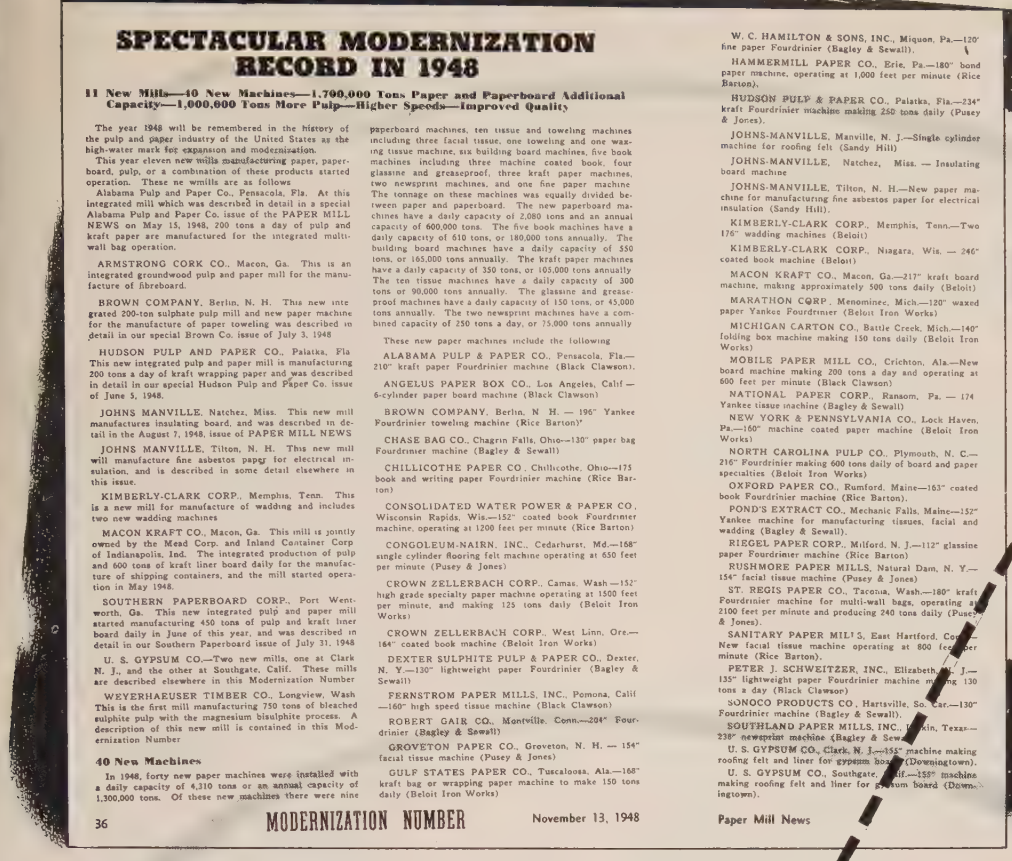

SPECTACULAR MODERNIZATION RECORD IN 1948

11 New Mills—40 New Machines—1,700,000 Tons Paper and Paperboard Additional Capacity—1,000,000 Tons More Pulp—Higher Speeds—Improved Quality

The year 1948 will be remembered in the history of the pulp and paper industry of the United States as the high-water mark for expansion and modernization.

This year eleven new mills manufacturing paper, paperboard, pulp, or a combination of these products started operation. These ne wmills are as follows

Alabama Pulp and Paper Co., Pensacola, Fla. At this integrated mill which was described in detail in a special Alabama Pulp and Paper Co. issue of the PAPER MILL NEWS on May 15, 1948, 200 tons a day of pulp and kraft paper are manufactured for the integrated multi-wall bag operation.

ARMSTRONG CORK CO., Macon, Ga. This is an integrated groundwood pulp and paper mill for the manufacture of fibreboard.

BROWN COMPANY, Berlin, N. H. This new integrated 200-ton sulphate pulp mill and new paper machine for the manufacture of paper toweling was described in detail in our special Brown Co. issue of July 3, 1948

HUDSON PULP AND PAPER CO., Palatka, Fla This new integrated pulp and paper mill is manufacturing 200 tons a day of kraft wrapping paper and was described in detail in our special Hudson Pulp and Paper Co. issue of June 5, 1948.

JOHNS MANVILLE, Natchez, Miss. This new mill manufactures insulating board, and was described in detail in the August 7, 1948, issue of PAPER MILL NEWS

JOHNS MANVILLE, Tilton, N. H. This new mill will manufacture fine asbestos paper for electrical insulation, and is described in some detail elsewhere in this issue.

KIMBERLY-CLARK CORP., Memphis, Tenn. This is a new mill for manufacture of wadding and includes two new wadding machines

MACON KRAFT CO., Macon, Ga. This mill is jointly owned by the Mead Corp. and Inland Container Corp of Indianapolis, Ind. The integrated production of pulp and 600 tons of kraft liner board daily for the manufacture of shipping containers, and the mill started operation in May 1948.

SOUTHERN PAPERBOARD CORP., Port Wentworth, Ga. This new integrated pulp and paper mill started manufacturing 450 tons of pulp and kraft liner board daily in June of this year, and was described in detail in our Southern Paperboard issue of July 31, 1948

U. S. GYPSUM CO.—Two new mills, one at Clark N. J., and the other at Southgate, Calif. These mills are described elsewhere in this Modernization Number

WEYERHAEUSER TIMBER CO., Longview, Wash This is the first mill manufacturing 750 tons of bleached sulphite pulp with the magnesium bisulphite process. A description of this new mill is contained in this Modernization Number

40 New Machines

In 1948, forty new paper machines were installed with a daily capacity of 4,310 tons or an annual capacity of 1,300,000 tons. Of these new machines there were nine paperboard machines, ten tissue and toweling machines including three facial tissue, one toweling and one waxing tissue machine, six building board machines, five book machines including three machine coated book, four glassine and greaseproof, three kraft paper machines, two newsprint machines, and one fine paper machine The tonnage on these machines was equally divided between paper and paperboard. The new paperboard machines have a daily capacity of 2,080 tons and an annual capacity of 600,000 tons. The five book machines have a daily capacity of 610 tons, or 180,000 tons annually. The building board machines have a daily capacity of 350 tons, or 165,000 tons annually. The kraft paper machines have a daily capacity of 350 tons, or 103,000 tons annually The ten tissue machines have a daily capacity of 300 tons or 90,000 tons annually. The glassine and greaseproof machines have a daily capacity of 150 tons, or 45,000 tons annually. The two newsprint machines have a combined capacity of 250 tons a day, or 75,000 tons annually

These new paper machines include the following

ALABAMA PULP & PAPER CO., Pensacola, Fla.—210" kraft paper Fourdrinier machine (Black Clawson).

ANGELUS PAPER BOX CO., Los Angeles, Calif.—6-cylinder paper board machine (Black Clawson)

BROWN COMPANY, Berlin, N. H. — 196" Yankee Fourdrinier toweling machine (Rice Barton)"

CHASE BAG CO., Chagrin Falls, Ohio—130" paper bag Fourdrinier machine (Bagley & Sewall)

CHILLICOTHE PAPER CO., Chillicothe, Ohio—175 book and writing paper Fourdrinier machine (Rice Barton)

CONSOLIDATED WATER POWER & PAPER CO., Wisconsin Rapids, Wis.—152" coated book Fourdrinier machine, operating at 1200 feet per minute (Rice Barton)

CONGOLEUM-NAIRN, INC., Cedarhurst, Md.—168" single cylinder flooring felt machine operating at 650 feet per minute (Pusey & Jones)

CROWN ZELLERBACH CORP., Camas, Wash.—152" high grade specialty paper machine operating at 1500 feet per minute, and making 125 tons daily (Beloit Iron Works)

CROWN ZELLERBACH CORP., West Linn, Ore.—184" coated book machine (Beloit Iron Works)

DEXTER SULPHITE PULP & PAPER CO., Dexter, N. Y.—130" lightweight paper Fourdrinier (Bagley & Sewall)

FERNSTROM PAPER MILLS, INC., Pomona, Calif.—160" high speed tissue machine (Black Clawson)

ROBERT GAIR CO., Montville, Conn.—204" Fourdrinier (Bagley & Sewall)

GROVETON PAPER CO., Groveton, N. H. — 154" facial tissue machine (Pusey & Jones)

GULF STATES PAPER CO., Tuscaloosa, Ala.—168" kraft bag or wrapping paper machine to make 150 tons daily (Beloit Iron Works)

W. C. HAMILTON & SONS, INC., Miquon, Pa.—120" fine paper Fourdrinier (Bagley & Sewall).

HAMMERMILL PAPER CO., Erie, Pa.—180" bond paper machine, operating at 1,000 feet per minute (Rice Barton).

HUDSON PULP & PAPER CO., Palatka, Fla.—234" kraft Fourdrinier machine making 250 tons daily (Pusey & Jones).

JOHNS-MANVILLE, Manville, N. J.—Single cylinder machine for roofing felt (Sandy Hill)

JOHNS-MANVILLE, Natchez, Miss. — Insulating board machine

JOHNS-MANVILLE, Tilton, N. H.—New paper machine for manufacturing fine asbestos paper for electrical insulation (Sandy Hill).

KIMBERLY-CLARK CORP., Memphis, Tenn.—Two 176" wadding machines (Beloit)

KIMBERLY-CLARK CORP., Niagara, Wis. — 246" coated book machine (Beloit)

MACON KRAFT CO., Macon, Ga.—217" kraft board machine, making approximately 500 tons daily (Beloit)

MARATHON CORP., Menominee, Mich.—120" waxed paper Yankee Fourdrinier (Beloit Iron Works)

MICHIGAN CARTON CO., Battle Creek, Mich.—140" folding box machine making 150 tons daily (Beloit Iron Works)

MOBILE PAPER MILL CO., Crichton, Ala.—New board machine making 200 tons a day and operating at 600 feet per minute (Black Clawson)

NATIONAL PAPER CORP., Ransom, Pa. — 174 Yankee tissue machine (Bagley & Sewall)

NEW YORK & PENNSYLVANIA CO., Lock Haven, Pa.—160" machine coated paper machine (Beloit Iron Works)

NORTH CAROLINA PULP CO., Plymouth, N. C.—216" Fourdrinier making 600 tons daily of board and paper specialties (Beloit Iron Works)

OXFORD PAPER CO., Rumford, Maine—163" coated book Fourdrinier machine (Rice Barton).

POND'S EXTRACT CO., Mechanic Falls, Maine—152" Yankee machine for manufacturing tissues, facial and wadding (Bagley & Sewall).

RIEGEL PAPER CORP., Milford, N. J.—112" glassine paper Fourdrinier machine (Rice Barton)

RUSHMORE PAPER MILLS, Natural Dam, N. Y.—154" facial tissue machine (Pusey & Jones)

ST. REGIS PAPER CO., Tacoma, Wash.—180" kraft Fourdrinier machine for multi-wall bags, operating at 2100 feet per minute and producing 240 tons daily (Pusey & Jones).

SANITARY PAPER MILLS, East Hartford, Conn.—New facial tissue machine operating at 800 feet per minute (Rice Barton).

PETER J. SCHWEITZER, INC., Elizabeth, N. J.—135" lightweight paper Fourdrinier machine making 130 tons a day (Black Clawson)

SONOCO PRODUCTS CO., Hartsville, So. Car.—130" Fourdrinier machine (Bagley & Sewall).

SOUTHLAND PAPER MILLS, INC., Lufkin, Texas—238" newsprint machine (Bagley & Sewall).

U. S. GYPSUM CO., Clark, N. J.—155" machine making roofing felt and liner for gypsum board (Downingtown).

U. S. GYPSUM CO., Southgate, Calif.—155" machine making roofing felt and liner for gypsum board (Downingtown).

all but 4

are equipped with ROSS Air Systems

During the year which saw the industry's high water mark for expansion and modernization, 36 of the 40 new machines installed were equipped with ROSS Air Systems to insure maximum operating efficiency. Plans are well under way for similar equipment in new mills to be built in 1949. Year after year, the records showing new and modernized machines continue to bear out the fact that fully 90% of the industry's mills are users of ROSS Systems.

ROSS SYSTEMS

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MEANS SERVICE AND QUALITY

For every type of Paper, there is a grade of quality Woodpulp, Chemical or Mechanical, which will do the job, and do it well.

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DU PONT REDS FOR PAPERS

Du Pont Brilliant Crocein FL Extra Conc.
Du Pont Congo Red
Du Pont Crocein Scarlet N Extra
Du Pont Fuchsine Conc. Powder
Du Pont Purpurine 4B Conc.
Du Pont Rhodamine B Extra
Du Pont Rhodamine 6GDN Extra
Du Pont Safranine T Extra Conc. 125%
Halopont* Brilliant Pink 2B
Lithosol* Red CSP
Pontacyl* Carmine 2B
Pontacyl* Carmine 2G Conc. 150%
Pontacyl* Fast Red AS Extra Conc.
Pontacyl* Rubine R Extra Conc. 125%
Pontacyl* Ruby PL Extra Conc. 200%
Pontamine* Fast Pink EB Extra
Pontamine* Fast Red 8BL Conc. 125%
Pontamine* Fast Scarlet 4BS Conc. 150%
Pontamine* Red 12B Extra Conc. 200%

*REG U. S. PAT. OFF.

What are your specific requirements as to shade . . . fastness . . . application method . . . furnish . . . cost? Whatever your problem may be, there's a Du Pont color which will suit your needs. Our Technical Staff is always ready to assist you. E. I. du Pont de Nemours & Co. (Inc.), Dyestuffs Division, Wilmington 98, Delaware.

DU PONT
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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Du Pont Dyestuffs

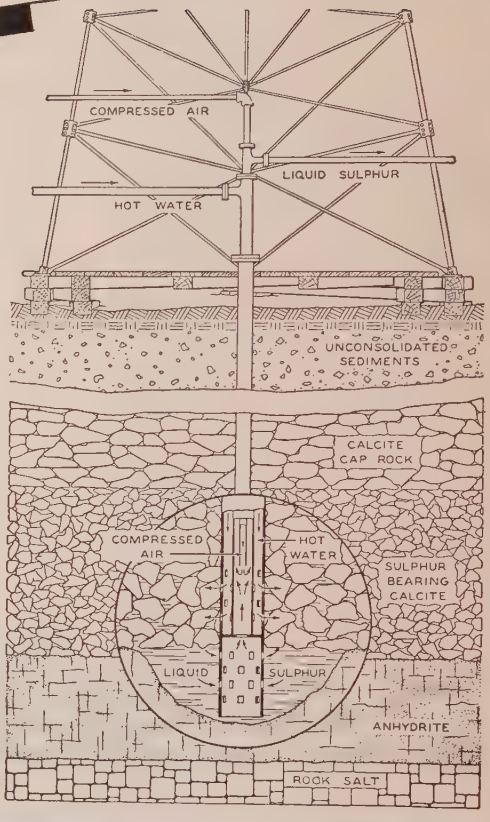
SULPHUR

*Interesting Facts Concerning This Basic Raw Material from the Gulf Coast Region

*WELL PIPING

The well equipment consists of pipes of various sizes, placed one within the other and extending from the surface into the sulphur deposit. A 10" or an 8" casing extends to and rests on the top of the cap rock. A 6" pipe, inside the casing, passes below it and reaches into the barren anhydrite. It is perforated at two different levels, separated by an annular collar. The upper set of perforations permits the hot water to enter the sulphur formation and the lower set permits the entrance of the molten sulphur to the discharge pipe fitted inside the 6" pipe.

When a well is "steamed" the hot water passes down the annular space inside the 6" pipe and outside the sulphur pipe and flows through the upper set of perforations into the porous formation. The entire mass through which the hot water circulates is raised to a temperature above the melting point of sulphur. The liquid sulphur being heavier than water, makes its way downward to form a pool and displaces water around the foot of the well, and rises in the well column through the lower perforations into a 3" pipe which is the sulphur discharge pipe. Compressed air released at the bottom of still another pipe fitted inside the 3" pipe rises and mixes with the sulphur column, forming an air lift which raises the liquid sulphur free of water to the surface.



Loading operations at one of the huge vats of Sulphur at our Newgulf, Texas mine. Such mountains of Sulphur are constantly being built at our mines, from which shipments are continually made.

TEXAS GULF SULPHUR CO. INC.
75 East 45th St. New York 17, N. Y.
Mines: Newgulf and Moss Bluff, Texas

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EMULSIFYING

A significant advance in rosin size technology is the development of the new Hercules Automatic Emulsifying Process.* Completely automatic, it converts Hercules Paste Rosin Size into a dilute emulsion. The new process saves considerable labor, eliminates the necessity for large storage tanks, requires a minimum of space. Easy to install, it also permits the use of certain types of sizes which could not previously be used because of inadequate emulsion stability. Many mills are adapting this process to their papermaking economy. Write for our new booklet.

HERCULES POWDER COMPANY

INCORPORATED

967 King Street, Wilmington 99, Delaware

*PATENT APPLIED FOR

PP9-1

EDITORIAL Tappi COMMENT

Another Annual Meeting

The Department of Commerce recently released a list of special national weeks, such as "Apple Week," "Printing Week," etc. In fact, the release indicated that there was a request for a "Let Us Alone Week," when no one would be pestered by tag sales. Although no "Paper Week" was listed there are few who are interested in pulp and paper who do not know that this is the last week in February.

It is an exciting week in New York with the multitudinous number of trade associations holding meetings of various kinds. It is the big week of the year for the Technical Association when more than eighteen hundred gather together to become abreast of the technical advances that have been made in the industry.

Much is crowded into this week. It is often difficult for a visitor to know just what he should do at any one time, considering the number of events that are held at the same time. The evenings offer the same abundance of choice, so much so, in fact, that no Association events are scheduled. New York and its nighttime attractions offer too much in competition.

Two events have become traditional during the TAPPI meeting, namely, the feature address at the luncheon and the medal presentation. This year the luncheon speaker is to be D. Clark Everest, President of the Marathon Corporation. Mr. Everest has spoken at the luncheon before and has always had an attentive audience. This year, his subject is "The Paper Industry As I See It," which might be anything, but those who will hear him know that many weeks of serious contemplation on the part of Mr. Everest will lead to wise counsel regarding the state of the industry and what may lie ahead.

The TAPPI Medal

This subject, mentioned in the previous item, merits independent attention. There is probably no event taking place during Paper Week that quite attains the prestige of the TAPPI Medal presentation. The medal is given to an individual who has made an outstanding contribution to the technical advancement of the pulp and paper industry. The final selection of the medalist is made by the Executive Committee after a special subcommittee has investigated the merits of the accomplishments of a number of carefully screened candidates. The subcommittee uses every resource at its command to find qualified candidates and proceeds to obtain the complete accurate record.

The list of TAPPI medalists of the past is impressive. The diversity of their contributions has been wide but all have used their active life-span to increase the material and factual wealth of their fellow man.

The 1949 medalist is no exception. Hardy S. Ferguson is a builder and he has built well. Mills scattered throughout North America stand as monuments to his engineering efforts. They say that a doctor can bury his mistakes, a lawyer's mistakes are to be found in prisons, but an engineer's mistakes stand out in full revelation for all to see. Mr. Ferguson undoubtedly made mistakes, probably more obvious to himself than to anyone else, but the year-in, year-out demand for his services as mill architect and engineer bears testimony to the high regard with which he has been held by the industry. His name is a worthy addition to the roster of TAPPI medalists.

U. S. Patents

In this issue appears one of the quarterly lists of United States Patents, a service that the Association has given to its members for many years through the efforts of Clarence J. West, Chairman of the TAPPI Bibliography Committee. Like everything else that Dr. West does, preparing the patent list requires much conscientious study and effort. There have been many expressions of appreciation for this service but, like nearly everything else, there is more likelihood that they have been taken for granted like the rising of the sun, debts, and taxes. It is well to stop, on occasion and recognize a good job, well done.

McGuffey and His Reader

George Peck in the *Link-Belt News* reminds us of another great American, who, like Benjamin Franklin contributed to the early advancement of the paper industry in the United States. William Holmes McGuffey was a schoolmaster. Through the medium of six humble school readers he was able to revolutionize education and formulate a national standard of character on which the new America of the late nineteenth century molded itself for fifty years. Except for the Bible and the dictionary, no books ever sold so many millions of copies. By 1880 they were being printed at the rate of two million a year. They featured truthfulness, industry, consideration for the weak, kindness, respect of conscience. However, it was not books he taught, but life; not words, but qualities.

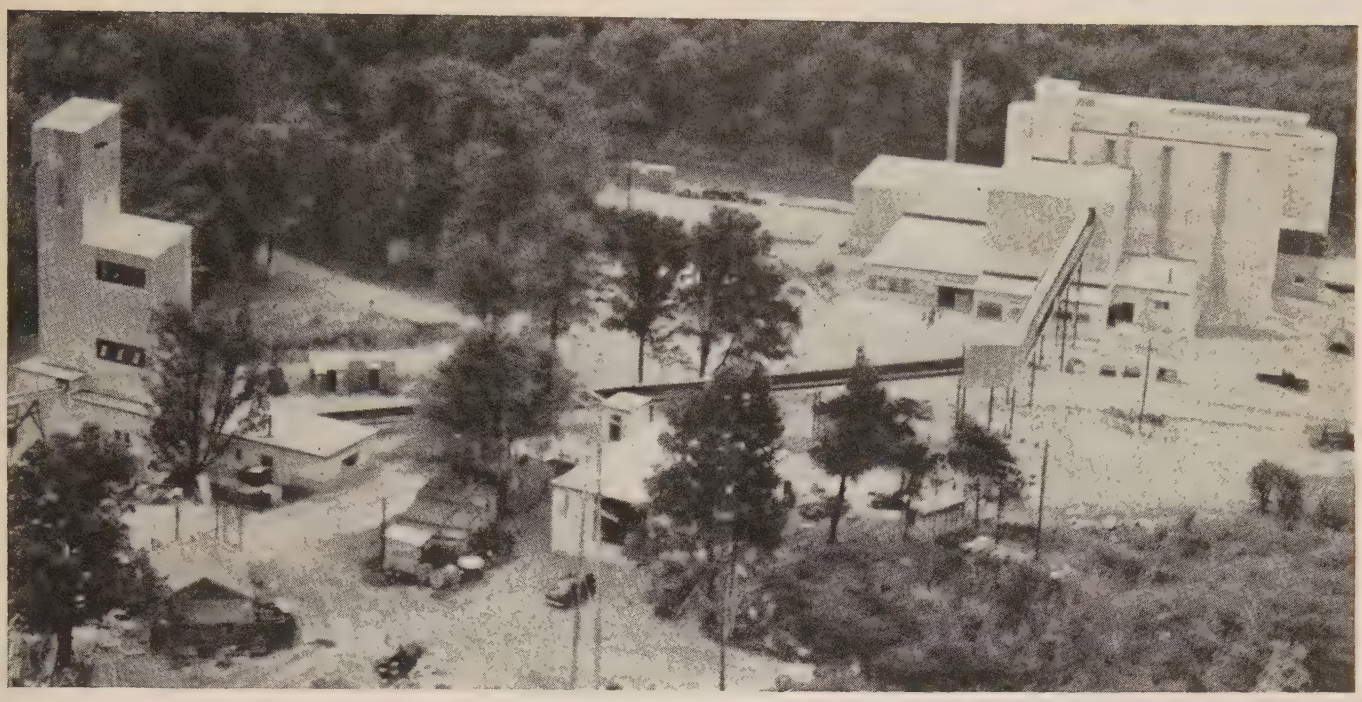
What has his contribution made to the development of the paper industry? He taught people to read and to want to read. The demand for just one pound of paper in printed or other form, per person, in any large nation is a considerable amount. Figure it out for a few teeming populations such as exist in the Orient, where the per capita consumption of paper is negligible.

A Letter to the Editor

Every now and then certain columnists devote a column to the letters that they receive in reference to some provocative column that they have written.

(continued on page 20)

OUR NEW TALC PLANT



Gouverneur Talc Co., Gouverneur, N. Y.

NYTAL

New York State Talc
for the Paper Industry
—Uniform Quality—

R. T. VANDERBILT CO. INC.

230 Park Avenue, New York 17, N. Y.

EDITORIAL COMMENT

(*continued from page 18*)

Since no one ever thinks of writing in commendation they usually start out "Dear Sir, you cad."

In technical journals, such as *Tappi,* there is little occasion to deal with letters such as these since they are not media of opinion on things abstract. Rather, they are records of scientific observations, measurements and conclusions based on these prerequisites. Technical magazines do, however, receive and welcome letters from their readers. They frequently add data to subjects recently discussed or they may be outright contributions of information for the benefit of other investigators. Generally, these contributions deal with a single point and do not merit the preparation of a formal technical article.

As Jimmy Durante would say they provide an opportunity for everyone "to get into the act." The International Association of Clubs of Printing House Craftsmen publish a small magazine entitled "Share Your Knowledge Review." Its members take this title seriously and are generous in sharing their knowledge with other craftsmen. The Technical Association and *Tappi* offer the same opportunity. The Association will have as much vitality as its members, on their own initiative, put into it. Since it deals with facts only, these must be furnished by those who have them. Sermonizing in this magazine will be limited to the space occupied by these editorials. A certain amount of it has its place. Even the Armed Forces did not proceed with the technical training of its men without carrying out an indoctrination program for the common good of all concerned. These editorials will be devoted to telling more and more about TAPPI's objectives and why they exist.

The C.P.P.A. Convention

In Canada and Great Britain the technical organization in the pulp and paper industry is a Technical Section of the industry's trade association. TAPPI was born that way and with more encouragement would possibly have remained in that category. Each year the pulp and paper convention season begins with the big meeting in Montreal. It is similar to Paper Week in New York and differs largely by the prominence given to woodland operations by the C.P.P.A. Woodlands Section. It is usually a fine meeting. As, at the TAPPI meeting, the universities, particularly McGill and the Government forest research organizations make worthy contributions. Newsprint, groundwood, and sulphite pulp manufacture tend to dominate the technical contributions. Several medals are presented, principally as awards for exceptional papers, and discussion of papers from the floor is much better than average for such meetings. There are a number of reasons for this enthusiastic and capable floor participation. A large proportion of the top executives of the Canadian companies are technically trained and have been active in the Technical Section. They encourage active participation by the men presently engaged as mill engineers, chemists, and superintendents and they enable these men to carry on work throughout the year that can be reported at meetings of the Section. In fact, on many occasions men from several mills have congregated in one mill for the purpose of carrying on a test or an investigation of a process. With this fine background the success of the C.P.P.A. Technical Section can be understood.

Other TAPPIS

While we are on the subject we might comment on the organizations, similar to TAPPI in other countries. In each of the Scandinavian countries, there is an association of pulp and paper chemists and engineers. The same applied to Germany, where such an organization is now being revived.

Following the recent war, technical men from France, Australia, and India have had a chance to observe TAPPI in action and have molded technical societies after it, creating the Association Technique de l'Industrie Papeterie, the Australian Pulp and Paper Industry Technical Association, and we have been advised that an Indian TAPPI is in the making. Possibly it has been established. We will know about this when other visitors from that tremendous new nation visit these shores.

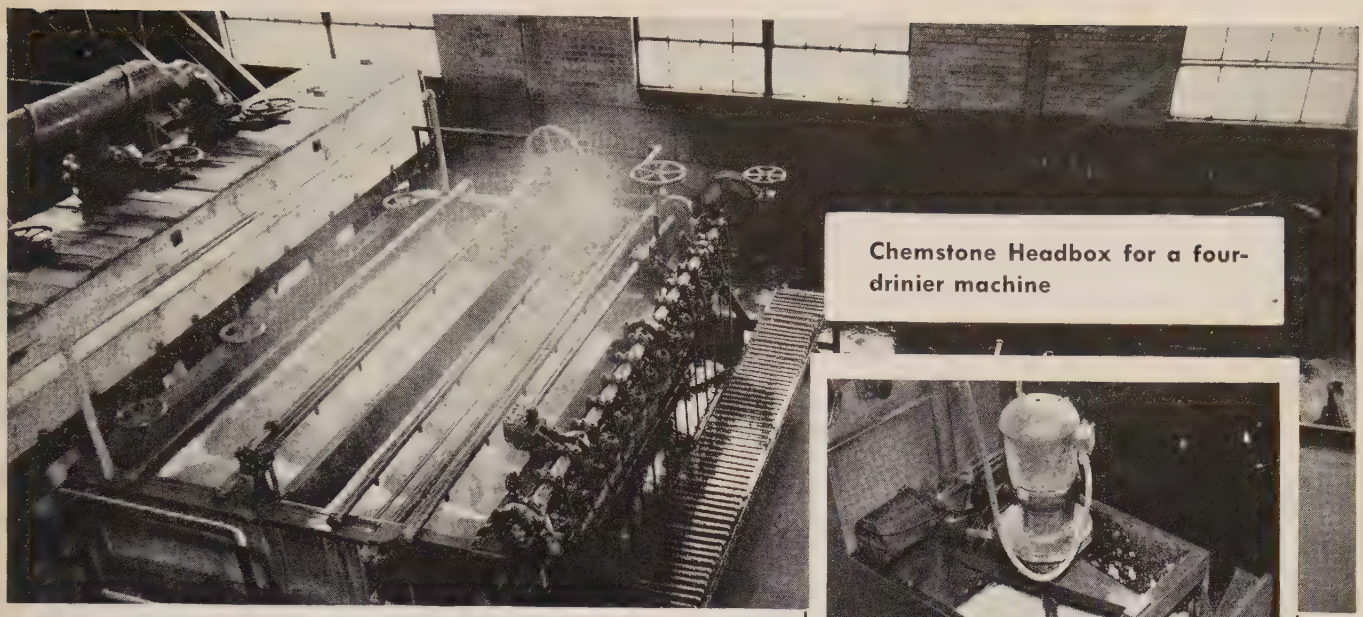
Local Sections in TAPPI

In this issue of *Tappi* the local sections of the Association start reporting. The nine sections have been reporting their meetings since 1929 when the first TAPPI Section was organized on the Pacific Coast. These reports have appeared in various trade papers. Recently, the sections were asked to establish committees on publications to report the proceedings of their meetings and to review technical presentations at their meetings for recommendation to the *Tappi* Editorial Board for publication.

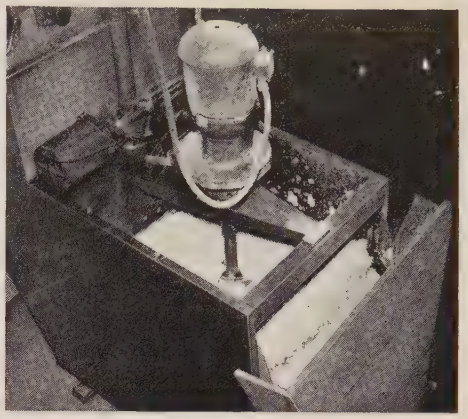
Because of the backlog of meeting reports this issue endeavors to review some of the current year's activities. In later issues these reports will be on a current basis.

The TAPPI local sections function on practically an autonomous basis, depending on their local leadership, for administration and programs. This has been one of the reasons for their survival during all kinds of economic conditions and why they have served their localities so well. Papermakers like to get together and anyone who is employed in the industry or interested in its technical aspects is welcome to attend meetings. Membership in the national organization is not a prerequisite for membership in a section.

As time goes on it is expected that many papers will be presented at section meetings of sufficiently high standard to be acceptable for publication in *Tappi.* There have been many in the past that would have rated this distinction, although, for the most part, some sections have preferred the more informal presentations of subjects that have been previously presented at national meetings. There is much to be said in favor of both types of talks, particularly since a large proportion of the individuals attending section meetings are young and new in the industry and can benefit more by popular talks by good speakers.



Chemstone Headbox for a four-drinier machine



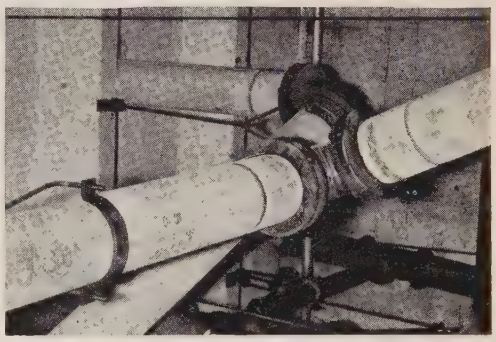
Chemstone Consistency Regulator Box handling poplar groundwood

Chemstone builds better boxes

YOU CAN'T MISS GETTING BETTER BOXES when you build with J-M Chemstone. Better because they will not swell or shrink . . . will remain unaffected by the severe operating conditions of a hard-driven pulp and paper mill.

Paper mill operators have found that Chemstone boxes are free from metallic oxides, resist both mild alkalis and acids. Chemstone boxes also prove unusually resistant to the accumulation of slime and bacteria —but when flushing *is* necessary (as in the handling of some groundwoods), Chemstone boxes are easily cleaned by the simple process of hosing down.

An asbestos product, Chemstone is strong though relatively light in weight. It can readily be worked into headboxes, consistency regulator boxes, flow boxes . . . as well as linings for wire and couch pits and similar applications. Only ordinary metal-working tools are required. Chemstone Cement, applied like putty, gives extra protection and water-tightness in covering bolts and making up joints. For full details, write Johns-Manville, Box 290, New York 16, N. Y.



Bleached Stock Lines of Transite Pipe

. . . And TRANSITE PIPE reduces sliming—helps keep stock lines clean!

Made of asbestos and cement, this pipe has proved its value for white water lines, stock lines, washed pulp lines, and service water lines. It is a low friction pipe that saves power and is free from metallic oxides. Its fibrous nature provides excellent resistance to shock loading. Light in weight and easy to handle, Transite Pipe also cuts installation time and costs.

Johns-Manville PRODUCTS FOR THE PAPER INDUSTRY

TAPPI Annual Meeting Program

Commodore Hotel, New York, N. Y., February 21–24, 1949

MEETING OF MONDAY, FEBRUARY 21

10:00 a.m. First General Session (East Ball Room)

W. F. Gillespie, Gaylord Container Corp., Bogalusa, La., *Chairman*

1. Secretary's Report, by R. G. Macdonald.
2. President's Address, by W. F. Gillespie.
3. "Our Water Resources," by Edward N. Munns, Chief, Division of Forest Influences, U. S. Dept. of Agriculture, Washington, D. C.

2:00 p.m. Committee Meetings (Grand Ball Room)

(Monday afternoon, February 21, will be reserved principally for meetings of all of the Association's committees to discuss current projects and plan future work.)

MEETING OF TUESDAY, FEBRUARY 22

9:15 a.m. Statistics (West Ball Room)

T. A. Pascoe, Nekoosa Edwards Paper Co., Port Edwards, Wis., *Chairman*

1. "Testing and the Statistician," by J. B. Catlin, Kimberly-Clark Corp., Neenah, Wis.
2. "Statistical Control of Paper Quality. I. Basis Weight and Moisture Content," by Charles M. Koon and W. F. Pease, Munising Paper Corp., Munising, Mich.
3. "Mathematical Treatment and Mistreatment of Experimental Data," by T. K. Sherwood and H. S. Mickley, Mass. Inst. of Technology, Cambridge, Mass.
4. "The Detection and Control of Tester Error," by J. H. Strieby, Kimberly-Clark Corp., Neenah, Wis.

9:15 a.m. Wet Strength (Room B-C)

K. W. Britt, Scott Paper Co., Chester, Pa., *Chairman*

1. "Wet Strength Paper Problems," by Borje Steenberg, Swedish Forest Products Laboratory, Stockholm, Sweden.
2. "Some Fundamental Aspects of Bonding Between Fibers," by Herman Mark, Polytechnic Institute of Brooklyn.
3. "Factors in the Strength of Paper," by Wilfred Gallay, E. B. Eddy Co., Hull, P. Q.

9:15 a.m. Paper Making (East Ball Room)

James J. Harrison, Michigan Carton Co., Battle Creek, Mich., *Chairman*

1. "The Kenwood Wheel as an Operating Tool," by Irving H. Peters, F. C. Huyck & Sons, Albany, N. Y.
2. "Curlated Pulp—A New Approach to Pulp Processing," by H. S. Hill, J. Edwards, and L. R. Beath, Price Brothers & Co., Ltd., Quebec, P. Q.
3. "The Curlator—Its Application to High Yield Newsprint Sulphite—Preliminary Report by Frank P. Silver," Price Brothers & Co., Ltd., Riverbend, P. Q.
4. "Reduction of Suction Roll Noise," by John P. Nash, Kimberly-Clark Corp., Neenah, Wis.
5. "Fast Cementing of Leather Belting Laps on Paper Mill Machinery," by Samuel L. Allen, J. E. Rhoads & Sons, Philadelphia, Pa.

2:00 p.m. Water (East Ball Room)

Miss Louise E. McGrath, Booth Chemical Co., Elizabeth, N. J., *Chairman*

Biochemical Oxygen Demand Session

1. "Adaptation of the B.O.D. Test to Pulp and Paper Mill Wastes," by Harry S. Gehm, National Council for Stream Improvement, New York, N. Y.
2. "Stream Pollution from Virginia Pulp Mills," by A. H. Paessler, Virginia State Water Control Board and L. L. Hedgepeth, Calco Div., American Cyanamid Co., Bound Brook, N. J.
3. "Technique of the Biochemical Oxygen Demand Determination," by D. Paul Rogers, Pennsylvania Department of Health, Harrisburg, Pa.
4. Paper, by F. W. Kittrell, Tennessee Valley Authority, Knoxville, Tenn.
5. "Aeration of Rivers," by L. Warrick, State Sanitary Engineer, Madison, Wis.
6. "Re-Seeding B.O.D. Bottles," by George Borden and Irene Woodcock, Riegel Paper Corp., Milford, N. J.

2:00 p.m. Structural Fibrous Materials (Room B-C)

John F. Campbell, The Flintkote Co., Meridian, Miss., *Chairman*

1. "An Engineering Approach to the Testing of Fiber Boards," by Wayne C. Lewis, Forest Products Laboratory, Madison, Wis.
2. "Evaluation of Fibrous Agricultural Residues for Structural Building Board Products, III. Manufacture of High Grade Products from Wheat Straw," by E. C. Lathrop and T. R. Naffziger, Northern Regional Research Laboratory, Peoria, Ill.
3. "Quality Control Method for Insulating Board Pulp," by Henry Mohrer and C. S. Conover, U. S. Gypsum Co., Chicago, Ill., and O. W. Frost, Wood Fibre Products Co., Forest Grove, Ore.
4. Panel Discussion on Coatings for Insulating Board, led by J. A. Killinger, Penick & Ford Ltd., Cedar Rapids, Iowa, and F. W. Egan, Bound Brook, N. J.
5. "Williams Freeness Test Studies on Insulating Board Stock," by C. E. Hrubesky, Forest Products Laboratory (by title).

2:00 p.m. Containers (West Ball Room)

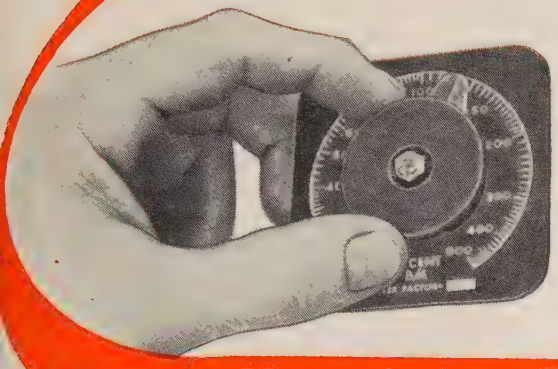
W. B. Lincoln, Jr., Inland Container Corp., Indianapolis, Ind., *Chairman*

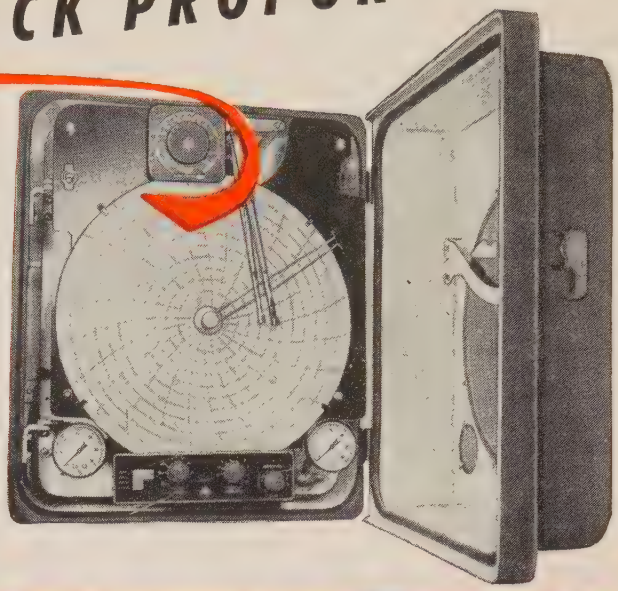
Symposium on Adhesives

1. "Studies in Water Resistant Pastes," by Edward H. Hill and Valentine X. Sliwinski, Corn Products Refining Co., New York, N. Y.
2. "Commercial Adhesives at Work," by D. D. Pascal, National Starch Products Co., New York, N. Y.

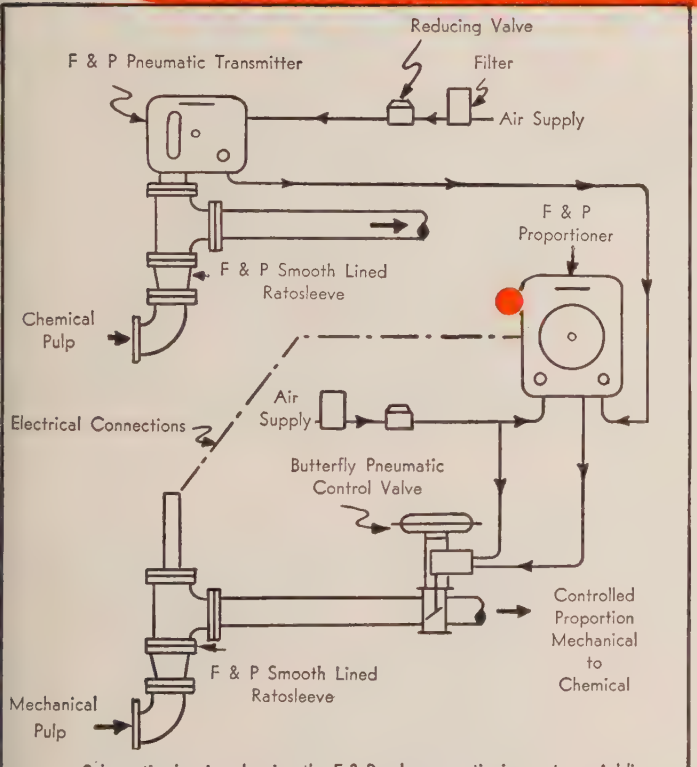
(continued on page 24)

A TWIST OF THE WRIST CHANGES SLUSH STOCK PROPORTIONS





THE NEW F & P PULP PROPORTIONING SYSTEM



Schematic drawing showing the F & P pulp proportioning system. Additional FLOWRATOR instruments are used when fluids such as broke, alum, and color are tied into the main line.

- **Eliminates Head Boxes**
- **Eliminates Pulp Return Lines**
- **Provides "Basis Weight" Control**
- **Saves Floor Space**
- **Records and Totalizes Pulp Flow**

Yes and more! The new F & P slush stock proportioning system . . . based upon the modern science of instrumentation . . . is rapidly replacing cumbersome and bulky compartment type feeders.

F & P INTEGRATED control systems start at the paper machine and, from the measurement of its speed, control pulp flow rate. Stock chest level . . . chemical to mechanical pulp ratio . . . size . . . color and filler flow rates are all "tuned" to exact proportion by a simple-

TWIST OF THE WRIST.

Write for technical bulletin "New Developments in Pulp and Paper Mill Instrumentation."

FISCHER & PORTER CO.
Dept. 9M-7P, Hatboro, Pa.

FLOWRATOR
TRADE MARK

INSTRUMENTS FOR FLOW RATE MEASUREMENT AND AUTOMATIC FLOW CONTROL

ANNUAL MEETING PROGRAM

(*continued from page 22*)

3. "Packaging Adhesion," by Frank G. Morehouse, National Biscuit Co. Laboratory, New York, N. Y.
4. "Silicate Adhesives," by R. L. Kreyling, Philadelphia Quartz Co., Philadelphia, Pa.

MEETING OF WEDNESDAY, FEBRUARY 23

9:15 a.m. Water (East Ball Room)

MISS L. E. MCGRATH, *Chairman*

Water Coagulation Session

1. "Cooling Water," by V. J. Calise, Liquid Conditioning Corp., Linden, N. J.
2. "Coagulants Used for White Water Clarification in the Flotation Process Under Vacuum as Applied in the Savalla Saveall," by B. Niberger, Castle & Overton Co., New York, N. Y., and R. E. Bodette, St. Regis Paper Co., Deferiet, N. Y.
3. "Flocculation for Flotation as Employed in the Sveen-Pederson Saveall," by Paul Easton and R. A. Baum, Bulkley, Dunton Co., New York, N. Y.
4. "Settling Waste Materials from Pulp and Paper Mill Waste Waters and Handling Bulk Solids Over Experimental Vacuum Filters of the Komline and Dorr Types," by A. S. Erspamer, P. H. Glatfelter Co., Spring Grove, Pa.
5. Paper, by Infilco, Inc., Chicago, Ill.
6. "Naturally Filtered Water Through Induced Filtration from Surface Water Bodies," by Leland Glidden, Ranney Water Collector Corp., Columbus, Ohio.

9:15 a.m. Graphic Arts (West Ball Room)

R. H. SIMMONS, Government Printing Office, Washington, D. C., *Chairman*

1. "A New Printing Ink Drying Tester," by Everett F. Carman, Montclair, N. J.
2. "Paper for Webb Offset Printing," by Milton Zucker, Interchemical Corp., New York, N. Y.
3. "Xerography and Xeroprinting," by R. M. Schaffert, Graphic Arts Research Div., Battelle Memorial Institute, Columbus, Ohio. (Paper followed by sound-film.)
4. "Ink Mileage for Various Inks on Various Papers," by A. C. Zettlemoyer, National Printing Ink Research Institute, Bethlehem, Pa.

9:15 a.m. Pulping and Related Processes (Room B-C)

H. W. BIALKOWSKY, Pulp Div., Weyerhaeuser Timber Co., Longview, Wash., *Chairman*

1. "The Solubility of Sulphur Dioxide in Magnesium Bisulphite Solutions," by F. H. Conrad, Missouri School of Mines and Metallurgy, Rolla, Mo., and D. B. Brice, Kansas State College, Manhattan, Kan.
2. "The Effect of Sodium Peroxide Bleaching on the Components of Spruce Groundwood," by Gary W. Jones, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
3. "Spray Drying Coefficients for Sulphite Waste Liquor," by L. C. Jenness, and R. M. Stinchfield, University of Maine, Orono, Me., H. H. Folger, Eastman Kodak Co., Rochester, N. Y., and F. H. Herbolsheimer, Marinette Paper Co., Fort Edward, N. Y.
4. "Commercial Lignins," by Arthur Pollak, New York, N. Y., and Robert S. Aries, Brooklyn Polytechnic Inst., Livingston St., Brooklyn, N. Y.
5. "Steam and Water Cooking of Aspen Chips," by J. N. McGovern and K. J. Brown, Forest Products Laboratory, Madison, Wis.
6. "Continuous Production of Yeast from Sulphite Waste Liquor on a Laboratory Scale," by A. E. Markham, H. D. Agar, and J. L. McCarthy, University of Washington, Seattle, Wash. (by title).

2:00 p.m. Alkaline Pulping (West Ball Room)

K. G. CHESLEY, Crossett Lumber Co., Crossett, Ark., *Chairman*

1. "The Pulp and Paper Laboratory of the University of Georgia," by George B. Hills, Jr., and William J. Nolan, Engineering and Industrial Experiment Station, University of Florida, Gainesville, Fla.
2. "A New Mechano-Chemical Process for Pulping Agricultural Residues," by S. I. Aronovsky, Northern Regional Research Laboratory, Peoria, Ill.
3. "The Hydrolysis of Sodium Sulphide in Mixtures with Sodium Hydroxide," by George E. Martin, Mosinee Paper Mills, Mosinee, Wis.
4. "Effect of Buffering Agents in Sodium Sulphite Semi-chemical Pulping," by J. N. McGovern and E. L. Kelly, Forest Products Laboratory.
5. "Deinking Studies III. Survey of a Production System by Screen Analysis" by H. P. Bailey and J. J. Forsyth, International Paper Co., Niagara Falls, N. Y.

2:00 p.m. Plastics (Room B-C)

E. C. JAHN, New York State College of Forestry, Syracuse, N. Y., *Chairman*

1. "Influence of Resin Bonds on the Moisture Stability of Paper-Base Laminates," by P. Seidel, Westinghouse Research Laboratories, E. Pittsburgh, Pa.
2. "Specifying Paper Quality for Use in Phenolic Laminates," by H. A. Anderson, Western Electric Co., Hawthorne Works, Chicago 23, Ill.
3. "Paper Properties Which Contribute to Qualities of Plastics Laminates," by J. C. Pitzer, The Formica Co., Cincinnati, Ohio.

2:00 p.m. Preparation of Papermaking Materials (East Ball Room)

JOSEPH J. THOMAS, S. D. Warren Co., Cumberland Mills, Me., *Chairman*

1. "The Alkaline Hypochlorite Oxidation of Guar Mannogalactan," by Arthur J. Haug, Scott Paper Co., Chester, Pa.
2. "Mechanism of Water Resistance," by William S. Wilson, Monsanto Chemical Co., Everett, Mass.
3. "Mill Trials with Aluminum Chloride as an Alum Substitute," by C. C. Porter, Southland Paper Mills, Lufkin, Tex., and William H. Lane, Monsanto Chemical Co., Texas City, Tex.
4. "A New Liquid Penetration Test for Measuring the Sizing of Paper," by Donna Price, R. H. Osborn, and J. W. Davis, Hercules Powder Co., Wilmington, Del.

COLLEGE LUNCHEONS AND DINNERS

12:30 p.m. Univ. of Maine, Commodore Hotel

12:30 p.m. New York State College of Forestry, Hendrick Hudson Room, Roosevelt Hotel

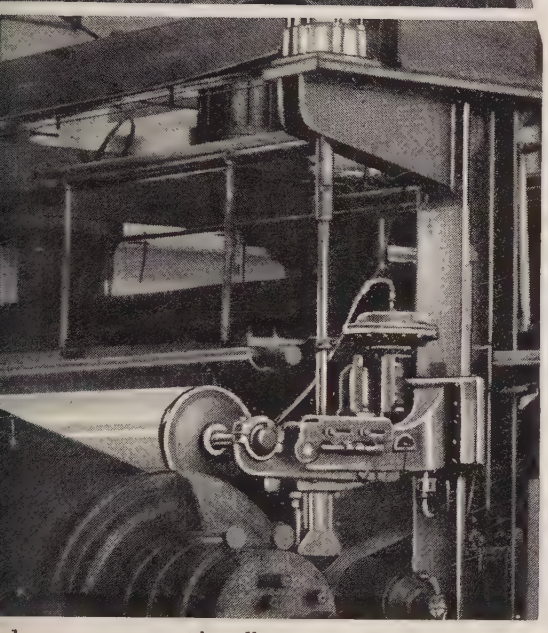
12:00 m. Massachusetts Institute of Technology, Engineers Club (32 W. 40th St.)

6:30 p.m. Institute of Paper Chemistry, Empire Room, Hotel Lexington

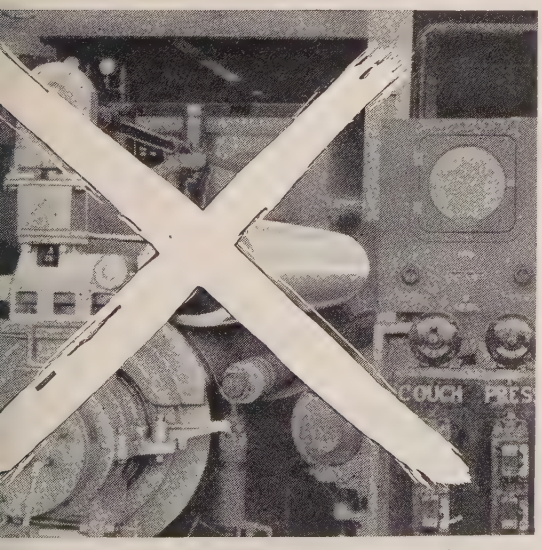
(*continued on page 26*)

How to Stop "Man-Handling" Lump Breaker Rolls

Lump breaker roll and paper draw roll are raised pneumatically when installing fourdrinier wire with the new Puseyjones arrangement.



ed arrangement with rolls in operating position.



the conventional mounting arrangement for lump roll on suction couch. Chain hoist is no longer l. Simplifies wire change.

In the new Puseyjones Machines, the lump breaker roll and paper draw roll are lifted pneumatically for fast, efficient wire changing. Both rolls are permanently supported from the adjacent press frames and can be raised or lowered with a finger touch. Check these important advantages:

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(2) Eliminates use of crane
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ANNUAL MEETING PROGRAM

(continued from page 24)

MEETING OF THURSDAY, FEBRUARY 24

9:00 a.m. Microbiological Control Methods (West Ball Room)

J. W. Appling, Buckman Laboratories, Memphis, Tenn., *Chairman*

1. "Bioassay of Slime Control Agents," by B. F. Shema and J. B. Anderson, Inst. Paper Chemistry, Appleton, Wis., and J. W. Appling, Buckman Laboratories, Memphis, Tenn.
2. "Further Studies on the Lethal Effect of Drier Rolls Upon Bacteria," by B. F. Shema.
3. "Equipment for Feeding Slime Control Toxicants Into Paper and Pulp Mill Systems," by Charles W. Dean, Buckman Laboratories, Memphis, Tenn.
4. "A Resistant Species of Penicillium from Groundwood Pulp," by J. W. Appling, Buckman Laboratories, Memphis, Tenn.
5. "Some Factors Influencing the Evaluation of the Effectiveness of Mold-proof Treatment of Paper and Paperboard," by George A. Cruickshank, National Aluminate Corp., Chicago, Ill.
6. "Establishing a Nontoxic Germicide," by C. H. Rogers, R. T. Vanderbilt Co., East Norwalk, Conn.
7. Panel Discussion—"The Significance of Microorganisms in Sanitary Grades of Paper and Paperboard."

9:00 a.m. Mill Instrument Control (Room A)

R. W. Porter, Fritz Publications, Chicago, Ill., *Chairman*

1. "Principles Governing the Choice Between Electric and Nonelectric Instruments," by David H. Fuller, the Foxboro Co., Foxboro, Mass.
2. "Instruments and Controls—Factors in Their Selection," by Harold A. Scholl, Brown Instrument Co., Philadelphia, Pa.
3. "Automatic Start-Up of Process with Reset Controllers," by H. R. Bristol, The Bristol Co., Waterbury, Conn.

9:00 a.m. Fundamental Research (Room B-C)

Harry F. Lewis, Inst. Paper Chemistry, Appleton, Wis., *Chairman*

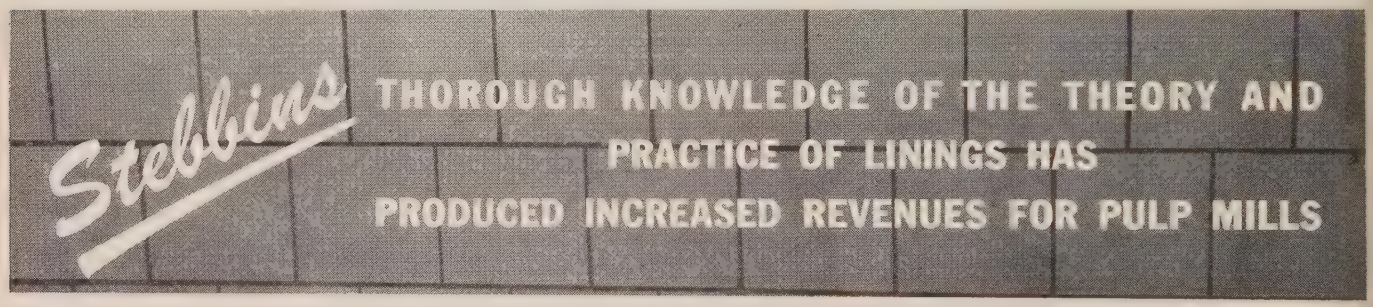
1. "The Measurement of Water Vapor Permeability at Low Temperatures by Means of the Hydrometric Sweep-Gas Method," by W. A. Wink and Leonard R. Dearth, Inst. Paper Chemistry.
2. "Correlation Between Hemicellulose and the Physical Properties of Bleached Kraft Pulps," by Francis T. Ratliff, Johns-Manville Research Laboratory, Manville, N. J.
3. "The Mechanism of Softening Paper by Glycerine," by William McPherson, Jr., International Paper Co., Glens Falls, N. Y.
4. "A Note on the Coefficients of the Kubelka-Monk Theory of the Scattering and Absorption of Light in Paper and Other Diffusing Media," by J. A. Van den Akker, Inst. Paper Chemistry, Appleton, Wis.

1:00 p.m. Annual Luncheon (Grand Ball Room)

W. F. Gillespie, *presiding*

TAPPI Medal Award to Hardy S. Ferguson (Presentation by M. H. Teaze).

"The Paper Industry as I See It," by D. Clark Everest, President, Marathon Corp., Rothschild, Wis.



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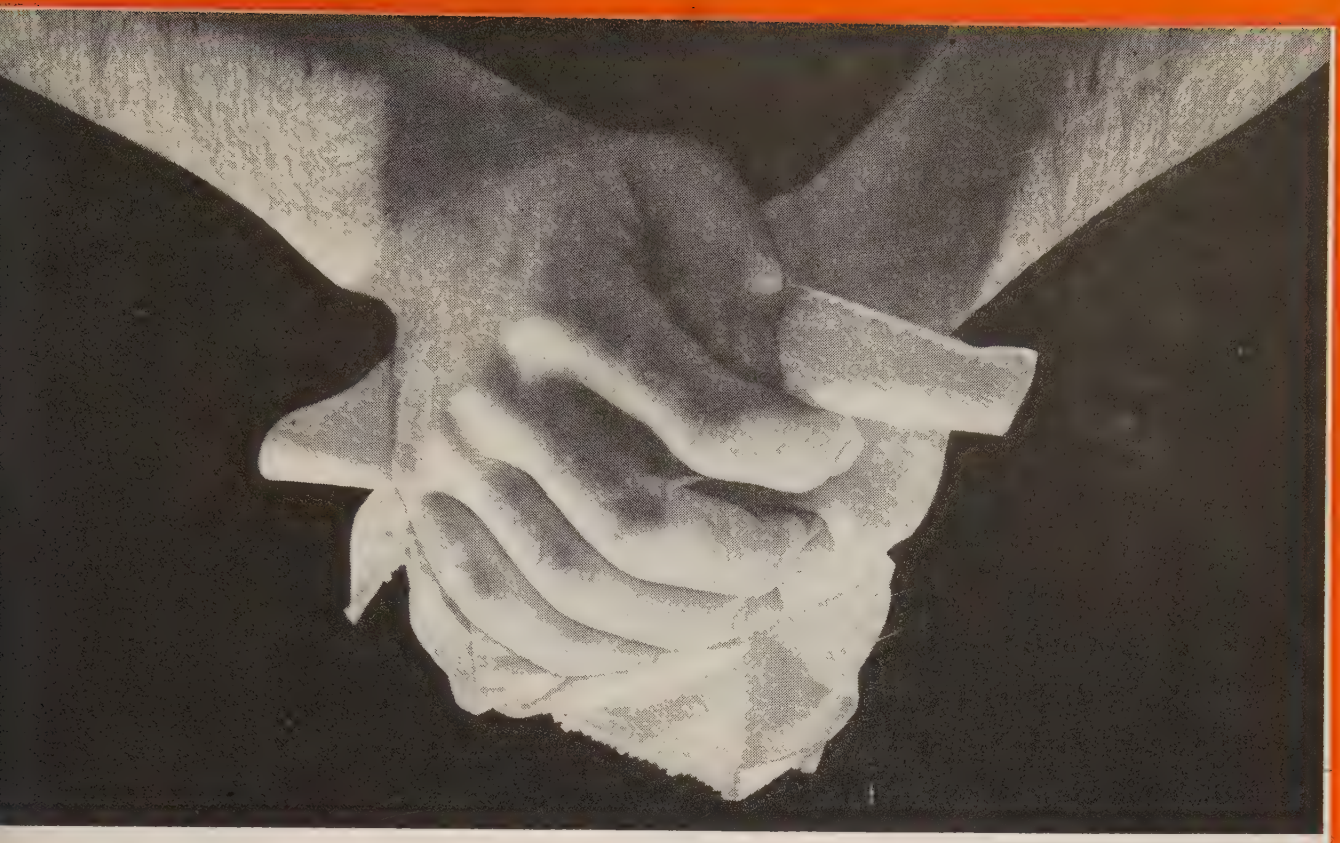

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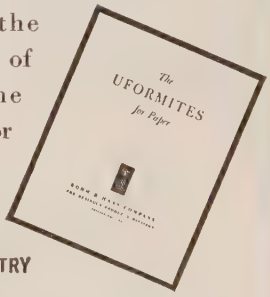

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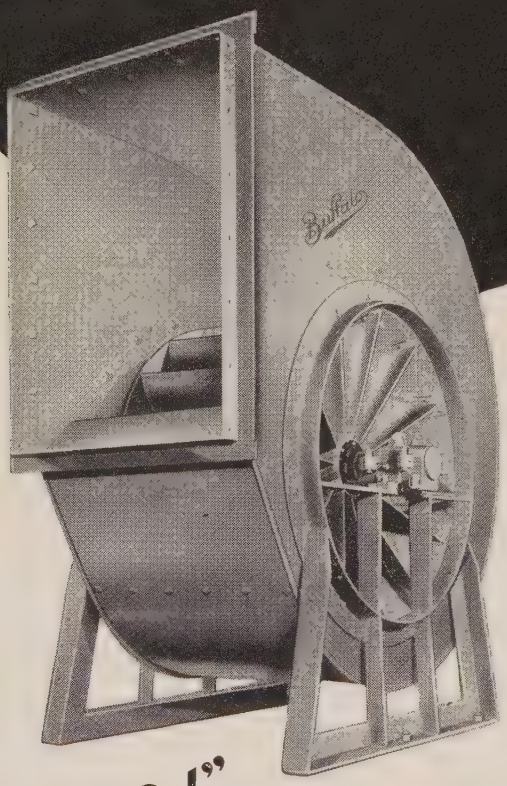

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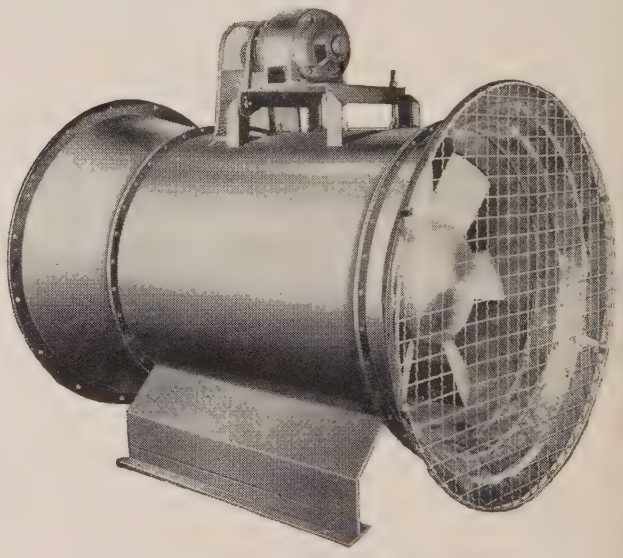

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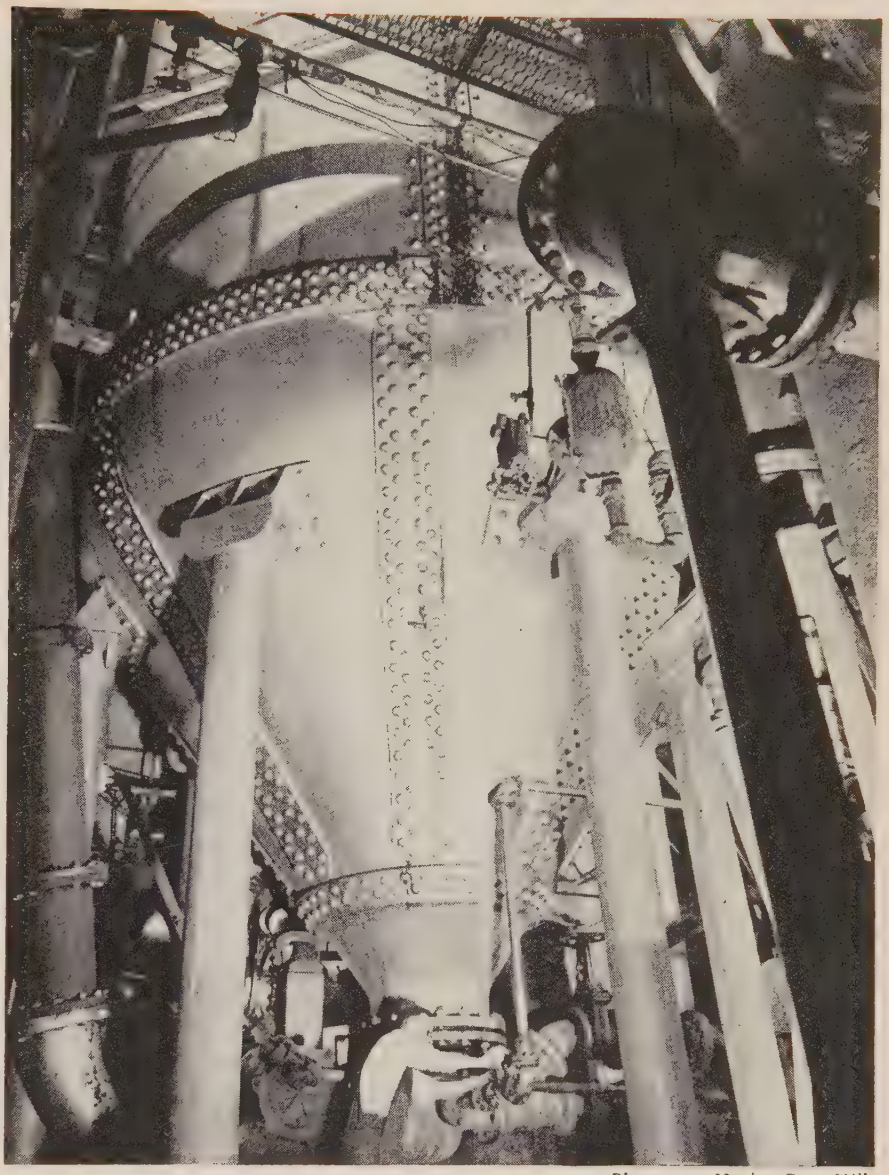

Photo courtesy Northern Paper Mills

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Units for recovery of chemicals and waste heat.

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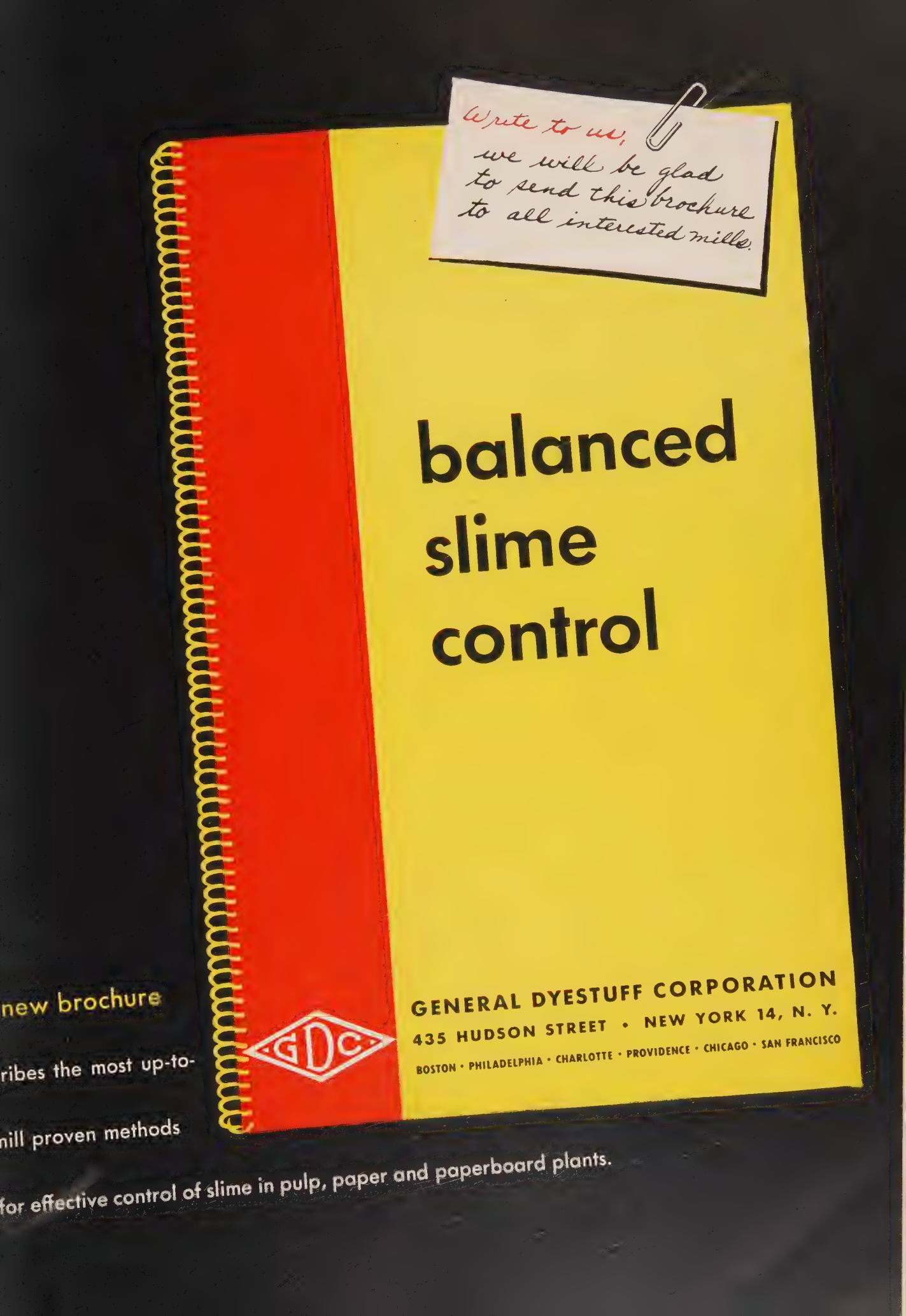
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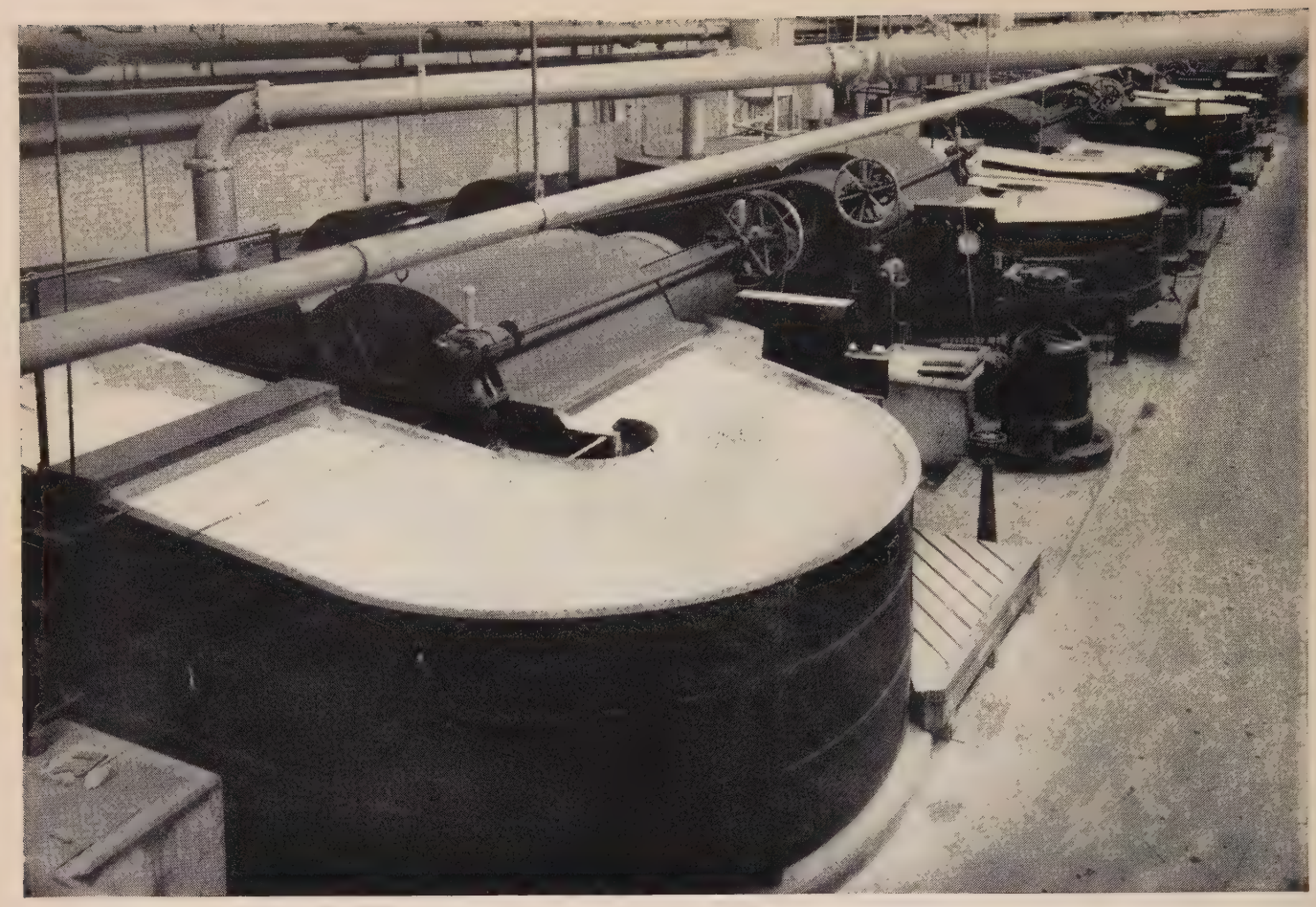

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These six beaters are doing from 3 to 5 times the work of which ordinary beaters are capable—processing around 50 tons each. Five of them are ahead of five machines running a wide range of specialty papers, each beater serving its own particular machine. The sixth is a spare.

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The Current Status of Vocational Training in the Paper Industry

I. The Quantitative Analysis

S. V. BALLOU and B. E. LAUER

As a result of a questionnaire prepared and distributed by the Technical Association of the Pulp and Paper Industry, replies were received from 122 companies representing 153 plants and mills. Some type of vocational training programs are in operation in 107 of the total number of plants and mills or in the communities in which they are located. More than one half of the 107 plants have educational courses both in the plant and the community. The 128 mills that gave employment figures employ a total of 92,401 workers of which 5,013 are currently receiving some sort of training.

The figures indicate that the larger the plant or company, the greater is the probability that it will have an in-plant educational program. They also reveal that the smallest plants induce a larger percentage of employees to take advantage of educational opportunities, where they are available, than do larger plants.

PROGRESSIVE businessmen are fully aware of the fact that well-trained workers are an economic asset to an organization, even though they may receive higher wages. It is then axiomatic that well-conducted programs of vocational training pay dividends, both directly and indirectly, to that industrial organization whose employees are engaged in any large number in such activities.

The Technical Association of the Pulp and Paper Industry indicated its interest in this feature of industrial activity by requesting the Vocational Training Committee to conduct a survey of existing training facilities both in and essentially for the paper industry, and from this survey to make recommendations for programs to fit the needs of various types and sizes of plants. Information was gathered by means of a questionnaire which was circulated to the industry through direct mail and through the pages of the TAPPI Bulletin. Some 200 copies of the direct mail questionnaire were distributed. Altogether, 153 mills indicated their interest in the project by completing and returning the questionnaire.

LIMITATIONS OF THE SURVEY

Evidence of the widespread appreciation of benefits derived from vocational training is indicated by the fact that out of the 153 companies answering the request, 107 companies reported that they have some sort of training facilities, either within the plant itself or in the community, or both, available to their employees. Before analyzing the results, however, certain limitations of the study should be observed.

Selection of the companies to whom questionnaires were to be sent was made by TAPPI headquarters. Care was used to make the circularization representative as to geographic location, size, and type of plant. About 50% of the total number of paper companies were sent questionnaires, and an attempt was made to contact a proportionate ratio of large and small companies in the country as a whole. This distribution did not, however, hold true in separate geographic regions.

Some companies with no training facilities available, although they returned the questionnaire, did not complete any part of it; as a result the number of employees in these plants is unknown. Closely related to this limitation is the fact that several plants which reported community training facilities as being available neglected to indicate how many of their employees were currently taking advantage of such facilities. There is no criticism of this lack of information since it can easily be understood that keeping a record of the number attending night school or taking a correspondence course would seem to be an uneconomical and pointless procedure. Nevertheless, for this reason, figures on the number of trainees enrolled in courses outside the plant are undoubtedly less accurate than those giving the number of trainees in regularly conducted programs within the plant.

The final limitation concerns the varying interpretations placed on the meaning of community facilities by those answering the questionnaires. It is evident that some interpreted the phrase broadly so as to include basic shop courses and even some academic subjects while others confined the meaning to courses that train for specific jobs in their particular plants. Whether or not these limitations would tend to cancel each other is problematical. They are, however, probably not serious enough to distort the impression of exsisting conditions conveyed by the survey or to render false the conclusions and recommendations made as a result of the findings.

REPORT DISTRIBUTION

Reports were received from mills located in twenty-four states representing the New England, Middle Atlantic, Southeastern, Central, Southwestern, and Pacific Coast papermaking regions. In addition, several mills in Canada and Newfoundland were included in the survey. Thirty-six per cent of the plants reporting are located in the Central States, 23.5% are in the Middle Atlantic States, and nearly 22%

S. V. BALLOU, Advisory Member, Vocational Training Committee, TAPPI; Associate Professor of Education and Teacher Trainer, Colorado A & M College, Fort Collins, Colo.
B. E. LAUER, Chairman, Vocational Training Committee, TAPPI; Professor of Chemical Engineering, University of Colorado, Boulder, Colo.

are in the New England States. Seventy-seven, or 50%, of the companies from whom data were received are located in five states: Maine, Massachusetts, Michigan, New York, and Wisconsin.

Of a total of 92,401, employees in the plants reporting employment figures, 5013 or 5.5% were reported as taking some sort of training. More than half the plants that have employees in training indicated that both plant and community facilities are available, but forty-six reported no provisions whatsoever for further education of their employees.

Kinds of Mills Involved

The first item on the questionnaire asked for a classification of the mill as to pulp, paper, conversion, or any combination of the three. For the purpose of providing a background for subsequent analysis, the responses are considered here. The returns show that slightly more than 35% are from paper mills, 23% are from pulp and paper mills, and nearly 21% are from pulp, paper, and conversion. Table I, below, gives the breakdown of types of plants according to size. Figures in parentheses tell the number of plants with some kind of vocational education program,

Table 1. Breakdown of Types of Plants According to Size

Number of employees	*1–249*	*250–499*	*500–999*	*1000–2999*	*3000 and over*	*No data*	*Total number of plants*
Pulp	1	...	1	...	...	...	2
			(1)				(1)
Paper	31	12	2	3	...	6	54
	(17)	(8)	...	(3)	...	(1)	(29)
Conversion	4	1	2	...	...	1	8
	(3)	(1)	(2)				(6)
Pulp and paper	2	8	16	4	1	5	36
	(2)	(2)	(14)	(4)	(1)	(2)	(25)
Paper and conversion	2	7	1	4	2[a]	1	17
	(1)	(7)	(1)	(4)	(2)		(15)
Pulp, paper, and conversion	...	5	12	3	2[b]	10	32
		(5)	(10)	(3)	(2)	(9)	(29)
Other	1	...	...	...	...	1	2
	(1)						(1)
No data	1	...	...	...	...	1	2
	(1)						(1)
Total number of plants	42	33	34	14	5	25	153
	(25)	(23)	(28)	(14)	(5)	(12)	(107)

[a] Includes the Robert Gair Company, Incorporated—3500 employees—no data given on number of plants.
[b] Includes the St. Regis Paper Company—11,000 employees—no data given on the number of plants.
Figures in parentheses indicate the number of plants in each classification that have some type of training facilities available for their employees.

either within the plant, in the community, or both. Small paper mills, taken as a whole, appear to be the weakest in the provision for formal training programs. As a matter of fact, the smaller plants, in general, are apparently faced with greatest difficulty in furnishing educational opportunities for their employees.

Kinds of Training Facilities

Further evidence that small plants face special problems in establishing formal educational programs is implied in Table II, which is a breakdown of types of training facilities available according to size of plant. For example, no mill of over 1000 employees is without some form of educational advantages of which the workers may make use. In mills smaller than 1000 the per cent of those having training facilities available to their employees decreases with the decreasing size of the mill. The increase in availability of programs to those in the larger mills appears to be largely due to increased interest of the plant itself. Whereas the group of companies having only community facilities available remains constant at about 20%, the portion with formal provisions within the plant for instructing their workers shows a steady increase from 38.1% for companies of less than 250 employees to 100% for those employing more than 3000. There actually, then, appears to be a direct relationship between the size of a mill and its ability or willingness to provide on-the-job training.

Table II. Breakdown of Type of Training Facilities Available According to Size of Plant

Number of employees	*1–249*	*250–499*	*500–999*	*1000–2999*	*3000 and over*	*No data*	*Total number of plants*
Plant and community							
Number of plants	10	11	20	5	4	8	58
Per cent	23.8	33.3	58.8	35.7	80.0	32.0	37.9
Plant only							
Number of plants	6	7	...	6	1	...	20
Per cent	14.3	21.2	...	42.9	20.0	...	13.1
Community only							
Number of plants	9	5	8	3	...	4	29
Per cent	21.4	15.2	23.6	21.4	...	16.0	19.0
No facilities							
Number of plants	17	10	6	...	...	13	46
Per cent	40.5	30.3	17.6	...	...	52.0	30.1
Total number of plants (100%)	42	33	34	14	5	25	153

Employees in Training

Not all companies that listed educational opportunities as available for their workers actually had men in training. By examining Table III below, it can readily be discerned that there is a positive correlation between number of employees and number of trainees. Only one mill of less than 500 employees had more than fifty men in training, while nearly 83% of these same size companies reported fewer than twenty-five employees in training. Of the latter group more than half list no employees as taking any form of training. Of the five largest companies each reported more than 250 current trainees.

Table III. Plants Classified According to Size and Number of Trainees

	Number of employees						
Number of trainees	*1–249*	*250–499*	*500–999*	*1000–2999*	*3000 and over*	*No data*	*Total number of plants*
500 and over	..	..	..	1	1	..	2
250–499	..	..	..	1	4	..	5
100–249	..	..	1	4	..	..	5
50–99	1	..	6	1	..	1	9
25–49	1	10	1	1	..	..	13
1–24	16	10	10	4	..	6	46
0	21	11	6	..	..	13	51
No data	3	2	10	2	..	5	22
Total number of plants	42	33	34	14	5	25	153

Table IV has been assembled for the purpose of bringing together, in summary form, the most important quantitative facts gleaned from the analysis of the completed questionnaire. Concerning the representativeness of the sample, it is interesting to note that although the number of mills reporting in the classifications 500–999, 1000–2999, and 3000 and over are 34, 14, and 5, respectively, the total number of employees in each classification is fairly constant at about 25,000. Of all the general observations, the

Table IV. Summary of Quantitative Results

Size of plant	1-249	250-499	500-999	1000-2999	3000 and over	Total or average
Number of plants[a]	42	33	34	14	5	153
Number of employees	5,880	12,650	24,143	24,197	25,531	92,401
Average number of employees per plant	140	383	710	1,728	5,106	722
Number of trainees	228	458	630	1,621	1,968	4,905[b]
Average number of trainees per plant	5	14	19	116	394	33[c]
Per cent of employees in training	3.9	3.6	2.6	6.7	7.7	5.3
Number of plants with trainee(s)	18	20	18	12	5	73
Number of employees in above plants	2,201	8,533	12,336	22,197	22,181	67,448
Per cent of employees above in training	10.5	5.4	5.1	7.3	8.9	7.3
Average number of trainees in above plants	13	23	35	135	394	67

[a] Twenty-five companies gave no data on the number of employees.
[b] One hundred eight trainees are omitted because total employment figures of the companies involved were not given in answering the questionnaire.
[c] Five thousand ninety-three is used as the number of trainees because the total number of companies was used in computing the average number of trainees per plant.

most unexpected one is the relatively small percentage of trainees in plants of from 500–999 employees. It is encouraging, however, that of those mills that have at least one worker in training, the smallest plants (under 250 employees) have the highest percentage of men so engaged.

CONCLUSION

From the reports which have been made, it seems conclusive that vocational education is feasible in plants of any size. The mere fact that a company is small is not sufficient reason for neglecting to consider the advantages that accrue from a formal program. It is also evident that, for the industry as a whole, the larger companies do a more consistent and thorough job of training. In view of the fact that some small companies have made a good record and that larger companies find formal training programs indispensable, it can be concluded that size is not, and should not be, an insurmountable handicap to incorporating a functional program, that there is widespread interest in educational programs within the paper industry, and that there is rather general appreciation of the values obtained through the organization and presentation of such programs.

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The Current Status of Vocational Training in the Paper Industry

II. The Qualitative Analysis

S. V. BALLOU and B. E. LAUER

A qualitative analysis of the replies obtained from a questionnaire on vocational training sent to some 200 pulp and paper mills has led to several general observations pertaining to the emphasis given to certain types of training.

The improvement of regular workers appears to receive the most attention in training programs with somewhat less attention being given to breaking in new men and upgrading personnel.

There appears to be a much wider availability of pre-employment training in the trades than in the craft of papermaking.

In general there appears to be little standardization of program, effort, or objective in the industry.

THE number of plants of various kinds and sizes with different types of training available, as reported in the first of these two papers *(1)*, is instructive and useful information; however, equally important and perhaps more necessary to the problem of improving conditions generally is that information that tells what kind of training is offered in the paper industry, for what purpose men are trained, and the types of agencies that contribute to the training program.

PRE-EMPLOYMENT VOCATIONAL TRAINING

The questionnaire *(1)*, asked for the type of instruction available under two headings, pre-employment vocational training, and on-the-job training for employees.

Table I shows that a total of 54 mills and plants have reported some type of pre-employment training facilities available for prospective employees. Thirty-six of these have plant and community training facilities, 2 have plant facilities only, and 16 have community facilities only.

It also reveals at least one other significant fact; only 13 plants of the 153 involved in the study are so situated as to be able to recruit, from the local community, workers who have had opportunity locally to obtain pre-employment training in papermaking. What can be done and what has been done in many cases to overcome this deficiency is to compensate for the lack of initial training with in-plant training programs for employees.

S. V. BALLOU, Advisory Member, Vocational Training Committee, TAPPI; Associate Professor of Education and Teacher Trainer, Colorado A & M College, Fort Collins, Colo.
B. E. LAUER, Chairman, Vocational Training Committee, TAPPI; Professor of Chemical Engineering, University of Colorado, Boulder, Colo.

Table I. Availability of Pre-employment Vocational Training

I. Number of Plants

	Number of employees						
	1–249	250–499	500–999	1000–2999	3000 and over	No data	Total number of plants
Number of companies							
Plant and community	6	7	16	3	1	3	36
Plant only	2	..	..	..	..	..	2
Community only	7	1	3	3	..	2	16
Total number of plants	15	8	19	6	1	5	54

II. Number of Responses

	Number of employees						
	1–249	250–499	500–999	1000–2999	3000 and over	No data	Total number of responses
Trades or crafts							
Plant and community	6	6	16	3	1	3	35
Plant only	1	..	..	..	..	..	1
Community only	6	1	3	2	..	2	14
Subtotals	13	7	19	5	1	5	50
Papermaking							
Plant and community	..	4	4	..	..	1	9
Plant only	1	..	..	..	..	..	1
Community only	2	..	..	1	..	..	3
Subtotals	3	4	4	1	..	1	13
Other							
Plant and community	..	2	12	1	..	..	15
Plant only	..	..	..	..	..	..	..
Community only	1	1	3	..	..	1	6
Subtotals	1	3	15	1	..	1	21
Subtotals							
Plant and community	6	12	32	4	1	4	59
Plant only	2	..	..	..	..	..	2
Community only	9	2	6	3	..	3	23
Total number of responses	17	14	38	7	1	7	84

A point worthy of note is that 35.2% of the pre-employment programs are to be found in companies of from 500 to 999 employees. This is in contrast to the relatively poor showing of this group in the per cent of employees in training *(1)*. A possible although somewhat dubious explanation of this fact is that, on the average, plants of this size may be located in towns which provide more specialized kinds of vocational training, thus providing men with stronger vocational backgrounds.

WORK EXPERIENCE

Work experience is a combination of pre-employment and on-the-job training. It is a plan whereby pupils spend approximately half a day in regular school work and half a day in business or industry learning a job or trade. A few companies reported such a program as being in operation, but it is doubtful that all had this type of plan in mind. Fibreboard Products, Incorporated, a large California company with plants in California, Oregon, Washington, Pennsylvania, and Maryland, enclosed the following pertinent information with their questionnaire:

Young boys of high-school age, who have shown aptitude for various trades in the vocational department of the high school and/or who may be interested in pulp and paper manufacturing are supplied to us by the local high school on a four-year training program. These apprentices attend school for one-half day and work at various jobs at our plant for the balance of the day. Time spent in school is credited as time worked, and time spent on the job is credited for completion of the high-school work.

The foreman on the job is designated as the teacher and receives a special teacher's certificate. The State Supervisor of Vocational Training, however, is responsible for the individual's progression in his school work. At the end of four years of such type of training the boy is then ready and qualified to take a full-time job in the plant in the trade for which he has been trained.

In regard to pay, the rate in the past has been established at a few cents lower than the base rate; however, this is subject to change from time to time, depending upon our relation with the Unions at the particular time. The only other requirement which must be met, in so far as our Union relationships are concerned, is that the boy, during his training period, must not replace a Bonafide Full Time Worker and Member of the Union.

While the program as above outlined is slightly different, depending upon the area in which the plant is located, the objective of this work-training program is common at all of the plants. One variation, for example, is that the boys begin their pre-vocational training when they are Juniors in high school and the program is carried on for two years, at which time, depending upon the type of job for which he is being trained, the boy either begins full-time work as a member or becomes a Bonafide Apprentice.

Although the Pacific Coast Association of Pulp and Paper Manufacturers is studying the question of apprentice and on-the-job training with a view toward making recommendations pertaining to this type of training, the management of the Fibreboard company feels that its program, as outlined, is well suited to the operations of this company and "serves to provide us with a ready source of available and qualified personnel."

TRAINING FOR EMPLOYEES

Section A2 of the questionnaire requested information regarding training for employees with the following items listed:

( ) Breaking in new men
( ) Preparation of old employees for new job
( ) Improvement of regular workers on their jobs
( ) Upgrading workmen
( ) Training potential foremen and superintendents
( ) Improvement of foremen and superintendents
( ) Preparation of instructors
( ) Other (please specify)

For convenience of classification in this analysis, the above items were grouped into the following three categories:

I Breaking in new men
II Improving regular workers
III Upgrading personnel

It is recognized that the process of upgrading personnel has as its byproduct the improvement of those workers in their regular work, especially during the time in which they are being trained and have not yet been promoted. However that may be, the distinction is necessary for the purpose of distinguishing the scope and objectives of the individual programs. A survey of the responses to this query is shown in Table II.

Of the plants in this tabulation, 37.4% reported all three kinds of instruction as being provided for their employees. This is encouraging in that it indicates fairly extensive programs in a large number of companies.

Emphasis among the three kinds of employee training programs is well balanced with only slightly more stress on the improvement of regular workers than on breaking in new men or upgrading personnel. Popularity of programs in plants that have both plant and community educational facilities available is apparent in that that particular group accounts for the bulk of all the responses for employee training. As a further extension of this observation, it can be noted that at 75% of the mills at which all three types of training are offered, the instruction is handled jointly by plant and community.

Apprenticeship Programs

A very important means of breaking in new men is the apprenticeship system. In answering the questionnaire, one company obligingly enclosed a copy of their 17-page "Apprenticeship Standards."

These Standards have as their broad purpose the establishment and the maintenance of high standards of workmanship,

Table II. Types of Instruction Provided for Employees

I. Classification by Number of Plants

	Number of employees						
	1–249	*250–499*	*500–999*	*1000–2999*	*3000 and over*	*No data*	*Total number of plants*
I—Breaking in new men							
Plant and community	1	2	1	..	..	..	5
Plant only	..	..	..	..	..	..	..
Community only	1	..	..	..	..	1	2
Subtotals	2	2	1	..	..	2	7
II—Improving regular workers							
Plant and community	1	2	..	..	..	..	3
Plant only	1	1	..	..	..	..	2
Community only	1	..	2	..	..	..	3
Subtotals	3	3	2	..	..	..	8
III—Upgrading personnel							
Plant and community	..	..	..	1	..	..	1
Plant only	..	..	..	1	..	..	1
Community only	..	1	..	..	..	..	1
Subtotals	..	1	..	2	..	..	3
I and II combined							
Plant and community	3	4	3	..	1	..	11
Plant only	1	..	..	..	..	..	1
Community only	..	..	..	..	..	..	..
Subtotals	4	4	3	..	1	..	12
I and III combined							
Plant and community	..	1	1	..	..	..	2
Plant only	2	1	..	1	..	..	4
Community only	..	..	..	..	..	..	..
Subtotals	2	2	1	1	..	..	6
II and III combined							
Plant and community	2	1	1	1	..	..	5
Plant only	1	4	..	..	1	..	6
Community only	..	2	1	3	..	..	6
Subtotals	3	7	2	4	1	..	17
I, II, and III combined							
Plant and community	2	1	14	3	3	7	30
Plant only	1	..	..	4	..	..	5
Community only	4	1	..	..	..	..	5
Subtotals	7	2	14	7	3	7	40
No data							
Plant and community	1	..	..	..	..	..	1
Plant only	..	1	..	..	..	..	1
Community only	3	1	5	..	..	3	12
Subtotals	4	2	5	..	..	3	14
Subtotals							
Plant and community	10	11	20	5	4	8	58
Plant only	6	7	..	6	1	..	20
Community only	0	5	8	3	..	4	29
Total number of plants	25	23	28	14	5	12	107

II Classification by Number of Responses

	Types of employee training			
	Breaking in new men	*Improving regular workers*	*Upgrading personnel*	*Total responses*
Plant and community	48	49	38	135
Plant only	10	14	16	40
Community only	7	14	12	33
Total responses	65	77	66	208

the development of the technical and theoretical aspects of their trade, to the end that they may acquire the skill and broad education to fit them for their responsibilities to their families as wage earners, to the industry as highly skilled craftsmen, and to the community as citizens.

The body of the agreement contains textual material covering fifteen areas of control as follows:

I. Joint Apprenticeship Committee
II. Qualifications for Apprenticeship Applicants
III. Term of Apprenticeship
IV. Supervision of Apprentices
V. Basic Work Schedule
VI. Related Technical Instruction
VII. Periodic Examination
VIII. Hours of Work
IX. Continuity of Employment
X. Adjustment of Differences
XI. Modification
XII. Certificate of Completion
XIII. Apprentice Wage Rate
XIV. Number of Apprentices
XV. Apprentice Agreement

The agreement must be signed by the apprentice, his parent or guardian, the employer, and the secretary of the state apprenticeship council. The appendices to the agreement list in considerable detail the requirements and training schedules for machinist, cutting and creasing pressman (paper box), printing pressman (paper box), die maker (paper box), maintenance machinist—millwright, papermaker, maintenance electrician, and maintenance carpenter. All schedules require 7424 hours of work and 576 hours of related instruction, making the term of apprenticeship four years.

Reports seem to indicate that apprentice programs are rather widespread. National Container Corporation, Jacksonville, Florida, stated that it participates in a plan operated by the machinists union through a council composed of labor and management. The Gilbert Paper Company, Menasha, Wisconsin, is in the process of incorporating an apprentice training program for veterans. Longview, Washington, conducts adult education classes in the evening in the public school; courses include apprenticeship classes in auto mechanics, body and fender work, carpentry, electrical trades, plumbing, machinist trades, and sheet metal. Hammermill Paper Company in Erie, Pennsylvania, has completed setting up standards of apprenticeship for machinists, millwrights, electricians, and maintenance pipefitters and sheet metal workers; they will become operative upon being signed by representatives of the company, the United Mine Workers of America, and the Apprentice Training Service of the United States Department of Labor. Bowater's Newfoundland Pulp and Paper Mills Limited indicated in its response that apprentice training is one of the three phases of their program. Most courses are of four years' duration, including a six months' period of probation, are under shop supervision, and include an appropriate correspondence course, paid for in full by the company. Employment of a full-time supervisor for apprentices and trainees is contemplated or an accomplished fact in most mills.

On-the-Job Training

Closely related to apprentice training is on-the-job training, especially as it is administered under Public Law 346, the veterans program. It is similar to apprentice training, but is designed primarily for situations not ordinarily included in an apprentice program. Men and women can, under provisions of this law, receive the same kind of training that would otherwise be unavailable to them because of age or because there is no apprenticeship program for the particular trade or industry which they are interested in entering.

Many varieties of company-financed, on-the-job training programs exist. Some last only until a worker can do his particular job. Others are considerably longer and are designed to give employees a broad background of understanding relative to the industry in which they work; some are quite formal with definite standards to be met, and others are very informal with only haphazard planning or none at all to characterize them. One rather unique plan reported consists of a Job Instruction Training department whose responsibility it is to train supervisors and instructors in the proper procedures of on-the-job instruction at the request of their respective superintendents.

Effect of the wartime Training-Within-Industry program is reflected by the St. Regis Paper Company, New York, in its attempt to improve the quality of workmanship of all employees, new and old. What is called on-the-job training consists of instructing new employees, improving job methods for older employees, and improving job relations through enlightenment of key personnel and supervisory groups. Union Bag and Paper Corporation, Savannah, Georgia, employs a similar system. The Hamilton, Ohio, and Canton, North Carolina, branches of the Champion Paper and Fibre Company finance on-the-job programs.

The Marathon Corporation plant in Menasha, Wisconsin, reported a plan geared for college graduates; 20 men are currently enrolled in progressive training that will take from 16 to 20 months to complete.

Correspondence courses, a vocational school, and the York Y.M.C.A. supply related instructional material for both apprentice and on-the-job training programs in the system established by the P. H. Glatfelter Company in Spring Grove, Pennsylvania.

Emphasis on general knowledge of the industry is the keynote of the plan of the Minnesota and Ontario Paper Company. The information given by this company on their three track plan is worth quoting for the suggestions it contains.

Conditional Employment Training Program

A. Under this program we aim constantly to have about five individuals of administrative assistant caliber in training. Generally these men are university graduates and are in the upper half of their class scholastically. The program is so scheduled that each of these individuals visits all departments of the company and all plants, spending sufficient time in each department so that at the completion of their training program they have a well-grounded knowledge of the company's operations from the cutting of the tree throughout all processing departments and to the ultimate consumer. In addition, they spend sufficient time in all administrative departments of the company so that they are familiar with these activities. The program takes approximately 10 months. When the individual completes the training program the various departmental heads signify whether or not they are interested in employing the individual in their particular department. The individual also is given an opportunity to voice his particular interest and

desires. Should there be no demand for the individual's services upon the completion of his training, it is understood that the company has no employment obligation to him. However, it is not contemplated that this situation will ever arise as the company has a considerable investment in each of these men, and upon completion of their training they can render valuable service in many different departments. These men are very carefully selected which militates against their falling by the wayside either during or at the completion of their training program.

B. We use an adaptation of the above program where new employees are hired for a specific position which carries some responsibility with it or which it is anticipated will grow into a responsible position. In these cases we tailor-make a program designed specifically for the particular position which the employee will hold. These programs usually are from 3 to 5 months in length and are for the purpose of giving the individual the broader background which is desirable for the responsibilities which he will be expected to carry.

C. As employees within the company advance to positions of responsibility which places them in contact with other operating units of the company particularly with plant offices other than the one in which they are employed, a short program is established, usually of one month or less, which will give these individuals an opportunity to spend sufficient time in the other plants or offices with respect to which they are concerned so that they will have a general knowledge of these other plants or offices.

Other Company Financed Programs

The remaining kinds of company-financed training programs can be classified under two headings, in-plant instruction and out-of-plant instruction. It should be recognized that in many cases a company contributes only a part of the expense in cooperating with some other agency, usually governmental. There are situations in which such cooperation is beneficial and even necessary to the maintenance of a worth-while program; however, for the purposes of this discussion, the arbitrary distinction will be made where possible.

In-plant instruction reached its peak during the war under the Training Within Industry Service, and according to reports obtained by this survey, the spirit continues to exert a desirable influence. Considerable time and effort is currently being devoted in many companies to operation of classes and schools for foremen, superintendents, and other supervisory employees. Frequently these programs are being conducted with emphasis on safety. The University of Minnesota sends an instructor to the Blandin Paper Company, Grand Rapids, once a week to conduct a course for foremen; it is given under the auspices of the State Board of Education. Hammermill Paper Company uses seminar discussions for improving assistant and regular foremen and superintendents.

One of the two phases of training emphasized by the St. Regis Paper Company, New York, is called Management Training, about which they have the following to say:

> . . . This involves the selection of young men of high aptitude and intelligence for the development through training into junior executive material. We have at the present time twenty-six men engaged in a three-year training program designed to familiarize them completely with the over-all picture of our organizations and in addition prepare them to skillfully handle one specific function. This program is being conducted under the G. I. Bill.

This company also provides an intensive training course for foremen and supervisors with the objective of enabling them to assume greater management responsibilities and "also very definitely to assume the responsibility for training for subordinates."

The Newfoundland plant previously referred to is conducting a regularly scheduled program of foreman training. It is explained as follows:

> The training of supervisors and foremen is carried out in the supervisors' association, the object being as far as possible to make them train themselves by discussion. This has proved most successful, and has improved the standard of foremanship considerably. The programmes are built up by the assistant mill manager, on a progressive plan which ensures that the work done at each meeting carries on where the last one left off. Meetings take place twice a month, and consist usually of a lecture by some outside specialist, a training film, and then an open forum for general discussion.

Courses for workers are as varied as those for the supervisory staffs. The Blandin Paper Company, Grand Rapids, Minnesota, conducts a course in papermaking based upon the operations of its own organization. The class meets once a week for 2 hours and is taught mainly by company foremen. The stated purpose of the program is to give employees a better understanding of the plant.

Company time is provided for a course in lubrication problems in the Rothschild plant of the Marathon Corporation in Wisconsin. Twenty operators are enrolled for ten 90-minute sessions, and the lubrication engineer instructs the class. Visual aids are utilized in papermaking, lubrication, combustion, and fuel efficiency classes at the P. H. Glatfelter plant. The Union Bag and Paper Company provides job training for breaking in new employees and for upgrading regular workers under the direction of line supervision and experienced workers with technical assistance extended by the training department. Supplementary training applicable to production, maintenance, technical, and office personnel is available at the plant and also through correspondence or at the vocational school.

The training program of the Champion Paper and Fibre Company is one of those worth mentioning separately because of its diversity and high quality. At the Hamilton plant, classes are operated in conjunction with the Hamilton Board of Education, the Trade and Industry Division of the Ohio State Board for Vocational Education, Miami University, and Hamilton High School; 39 courses, from pulp process control to public speaking, are offered. Much of the work is on the college level. Classes meet 2 hours a week, usually in the evening, for from 5 to 30 weeks. Training for employees in two of the three Champion plants is classified as follows:

A. Hamilton, Ohio
   1. On-the-job—company financed
   2. College level training (evening classes)—company financed
   3. Vocation evening trade extension—state supported
   4. Vocation evening courses—company financed

B. Canton, North Carolina
   1. On-the-job—company financed
   2. Vocational trade and industrial evening classes—one fourth company financed, three fourths state supported

The Canton division offers twenty-two courses of study consisting of a total of 105 separate subjects.

Although the Crown Willamette Paper School has

been discussed at some length (*2, 3*), the survey indicates an expansion of activities. The following quotation is from a letter enclosed by the company with the questionnaire:

> In cooperation with, and under the sponsorship of, the local high school, evening vocational classes in applied mathematics and blueprint reading have been made available under the Smith Hughes vocational education program, according to a plan for evening industrial school, approved by the State Board of Vocational Education. These classes are open to all employees without cost other than for textbooks and supplies.
>
> The company continuously carries on a program of vocational safety education and training and is expanding its application of the "J" courses, including Job Instruction Training, Job Method Training, and Job Relations Training, as improved by the Training Within Industry Foundation.

TESTING FOR EMPLOYEE APTITUDES

Nothing is more practical than to place men where, because of their capabilities and interests, they will become the most productive human units possible. To achieve such a high standard, workers cannot be placed haphazardly; the method must be as scientific as the most exacting research.

Much remains to be done in the field of testing prospective employees for special aptitudes and abilities. In spite of the fact that no program dealing with people can be as precise as production techniques, these programs are valuable, though difficult to properly organize. Hardtke's study (*4*) which includes 109 references to various tests, industrial psychology, and bibliographies, provides a substantial factual basis for planning an efficient program.

The following quotation illustrates the effort being made by the Robertson Paper Box Company in this type of activity:

> Before accepting apprentices for on-the-job training, they were sent to the Veteran's Night High School in New London, Connecticut, where they are given the Minnesota Occupational Rating Tests as prepared by Science Research Associates. These tests cover academic, mechanical, social, clerical, musical, artistic, and vocational interests. We feel that the results have been very satisfactory to date. I mentioned this program at this time because we intend to follow the same procedure in our Board Mill as soon as possible.

It should be emphasized that what the Robertson Company is doing for apprentices is equally applicable to any situation in which it becomes desirable to fill a vacancy.

CONCLUSIONS

From questionnaire returns, expert opinion as to what constitutes best practices, and the application of logic, the following conclusions are to be drawn:

1. Education in industry pays dividends beyond mere financial reckoning. *The Training Within Industry Report, 1940–1945* (*5*) supports this statement as does the wartime experience of the New York State Education Department, Division of Vocational Education (*6*).

2. Education in industry builds morale by bringing more system into the organization, by substituting the value of merit in promotions for that of favoritism, and by increasing workers' feelings of belonging and self-confidence.

3. Education, whether formal or informal, positive or negative, i.e., miseducation, is a never-ending process.

4. Limited only by his training, ability, and perspective, the alert, progressive businessman attempts to harness these educative forces and direct them toward results desirable to labor and management alike.

5. Although situations differ in the difficulties they place in the path of accomplishment, a workable training program is possible in any mill regardless of size, location, or absence of other educational facilities.

6. There is no master plan to be applied to the industry. Each plant may select the best practices suitable to its peculiar needs and its ability to put into functional operation such practices.

RECOMMENDATIONS

In light of the questionnaire returns in general and the resultant conclusions in particular, the following recommendations are made to members of the pulp and paper industry:

1. Every plant and mill should plan an educational program, irrespective of size and location of the plant, community facilities available, or limited scope and comparative informality of the educational plan.

2. There should be as little lag between theory and practice as is reasonably possible. That is not to say that there should be none; there must be constant evaluation and modification to benefit by experience and to meet changing conditions.

3. The program should be so designed as to meet best the needs and interests of the employees as well as of the company. Job analysis is necessary in order to be able to place men according to their interests and abilities. Such an analysis for the paper industry is to be found in a publication by the Federal Board for Vocational Education (*7*).

4. Job analysis alone does not guarantee that employees will be placed in jobs for which they are best qualified by reason of their aptitudes and interests. Tests and other types of measuring instruments are far from infallible; however, much has been accomplished in this field, and such aids are recommended for those who are interested in establishing a program on as scientific a basis as possible. The studies and writings of Drake (*8*), Hardtke (*4*), and Tiffin (*9*) can be of considerable value in providing recent information and tools with which to start a program.

5. Although there is not universal agreement on the point, it seems desirable to place one person in complete charge of the training program. Responsibility may be delegated to department heads, but in all cases, authority and responsibility must be commensurate.

6. Constant evaluation and modification has been mentioned as desirable. One of the most important means of building a sound basis for evaluation is through periodical literature. It is recommended, therefore, that the Director of Training be supplied with pertinent publications that will enable him to do an effective job.

7. Every educational program should include as many of the following phases as it is practical to put into operation:

a. Pre-employment training. The company may cooperate with local agencies, particularly the public schools, in designing, staffing, and equipping some phases of such a program.

b. Work experience. This should be, as a rule, a four-way agreement among industry, the school, the pupil and his parents, and the union.

c. Training for employees.

(1) Breaking in new men. This will include apprenticeship and on-the-job training.

(2) Improving regular workers. This will include development of an understanding of the entire process of which each job constitutes a part; increased knowledge, understanding, and skill on the part of each worker, foreman, and supervisor; safety education; and distribution of printed materials and posters.

(3) Upgrading personnel. This will be the same as improving regular workers except that increased knowledge, understanding, and skill shall apply also to the new job for which the employee is being trained.

8. Employee suggestions should be utilized. In addition to aiding production, morale is improved because the workers feel that they belong to the organization, that they count for something, that their opinions are worth while. All of this makes an educational program more effective in that employees will not be as suspicious of the company's motives in attempting to develop better workmen.

9. A degree of reciprocity to the last recommendation is contained in the suggestion that management inform its employees of its problems and aims. Occasional talks and distribution of printed materials will serve the purpose. The organized training program is an excellent avenue for this contact. If done in the right spirit, the result will be increased harmony and morale, and perhaps more important to management, increased efficiency.

10. The final recommendation is that industry and education make a real effort to bridge the gulf of misunderstanding of mutual problems that has existed too long. Typical of the efforts in this regard were the arrangements made in 1946 under the sponsorship of the Michigan State Department of Public Instruction whereby thirty public school principals and superintendents spent a day with each of twenty-eight business, industrial, and labor organizations studying industry and business with reference to their relationship to education (*10*). With each organization the day's visit included:

a. a review of the history and an overview of the organization;

b. a brief tour of the plant with opportunity to get worker reactions;

c. luncheon with department managers;

d. presentation and discussion of employment procedures, in-service training, human relations, public relations, counseling procedures;

e. suggestions for education and areas of cooperation between business, industry, and education.

The experiment was rated as most worth while by all of those concerned, both educators and businessmen. The above example is cited for the purpose of indicating a valuable type of cooperative effort and to stress the important outcomes that accrue from the working together of industry and education. As a result of experience, needs, and long range objectives, each can materially aid the efforts of the other.

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APPENDIX

VOCATIONAL EDUCATION QUESTIONNAIRE

Name and location of plant.

Please check type of plant: (a) paper, (b) pulp, (c) conversion.

Please check if any employee training program is available in your: (a) plant and/or (b) community.

If one is available, please indicate by checking in the proper spaces below the nature of the instruction being provided or made available as it applies to your particular situation.

A. Type of instruction available:
   1. Pre-employment vocational training: (a) trades or crafts, (b) papermaking, (c) other (please specify).
   2. Training for employees: (a) breaking in new men, (b) preparation of old employees for new job, (c) improvement of regular workers on their jobs, (d) upgrading workmen, (e) training potential foremen and superintendents, (f) improvement of foremen and superintendents, (g) preparation of instructors, (h) other (please specify).

B. Source of such instruction:
   1. Pre-employment vocational training: (a) public school: (1) day, (2) evening or night; (b) private school, not company financed; (c) company financed school; (d) university or college extension courses (name of college); (e) other (please specify).
   2. Training for employees: (a) company financed: (1) on-the-job, (2) outside of working hours; (b) private school (not company financed); (c) university or college extension courses; (d) public schools: (1) day, (2) evening or night; (e) other (please specify).

Do you participate in any sort of cooperative student work-experience program? If so, on what levels?

How many workers (all classes) do you employ?

How many are currently participating in some training program?

Name of the man in your plant responsible for training program?

We will appreciate a statement from you, to be attached to this questionnaire giving a description in as much detail as you care to use, of such programs of vocational education as may be available in your plant or community.

Wood—Its Preparation And Measurement

J. B. JONES

The more common methods of wood preparation as they are known in the East and particularly the methods in use at the plants of The Ontario Paper Company Limited are described. A flow sheet of the wood room at Thorold as designed to handle both barked and unbarked wood is shown. The various pieces of wood barking equipment are described. Explanation is given of the volumetric system of wood measurement, with illustrations, and methods of wood write-off are described. Some comments are made on the importance of wood density in wood purchasing and pulp yield.

BARKING

THE most common barker in the East is still the rotating barking drum which makes use of the abrasion principle to remove bark. The pulpwood logs are fed into a large, open-ended, slowly revolving drum where the logs are tumbled against each other thus rubbing off the bark.

By controlling the rate at which the logs are fed to the drum and the depth of the logs by means of a dam at the outlet, the time the log is in the drum, and the amount of abrasion it receives can be adjusted to suit the toughness of the barking. The drums are usually supplied with water nozzles which wash away the bark although drums are sometimes operated dry, chiefly in an effort to produce dry bark and thus improve its value as fuel.

There are two main types of barking drums. One where the drum is hung from chains in an effort to cushion the shock and thus prolong the life of the drum; in the other type the drum is supported on trunion wheels.

Most of the wood is brought to the author's plant by boat and the barking drums are located at the various loading points. The barking drums are all of the chain suspension type and measure 12 feet in diameter by 45 feet long. The capacity varies from 17 to 40 cords per hour each depending upon the condition of the wood at the time of barking. The rate increases with greener wood and during the warmer weather. The wood runs 45 to 50% moisture content at shipment. At the plant in Thorold there are four drums 10 feet in diameter by 30 feet long. Two of these are of the trunion type and originally handled all of the wood almost all of which was received in a barked condition in earlier days and, consequently, the drums were used only for washing purposes. Since then a certain amount of rough wood has been purchased and to bark this two extra 10 feet in diameter by 30 feet long drums of the chain suspension type have been installed. A few figures on the amount of wood barked with these 10- by 30-foot drums might be of interest. On spruce running around 35% moisture content, during the summer months, about 5 cords per hour each can be put through these drums; however, during the winter months when the wood is frozen not more than 2 to 3 cords per hour each is produced.

J. B. JONES, The Ontario Paper Co. Ltd., Thorold, Ont.

Thorne Barkers

There are a few installations of Thorne barkers in operation. This barker also makes use of the abrasion principle to tear the bark off the logs. The logs are sorted and directed into a set of three pockets one behind the other. In the bottom of each pocket double-ended cams are set up and revolve at a low speed in the range of 15 r.p.m. The action of these cams lifts the logs and gives them a rolling motion over each other thus rubbing off the bark. The logs move on from one pocket to the other and any incompletely barked logs are returned to the inlet and recirculated for a further pass. Water is sprayed over the logs washing the wood and flushing away the bark. The bark falls to the bottom of each pocket as it leaves the logs and passes out of the pocket through slots. The capacity of this barker is variously stated to be 10 to 18 cords per hour. It has the important advantage that it does not broom the ends of the logs such as is experienced with drum barkers.

Hydraulic Barking

Hydraulic barkers have found their widest use on the Pacific Coast, because drum barkers are not suited to handling the large logs encountered in the West Coast mills. The principle of these barkers consists basically of moving a jet of high pressure water and the surface of a log relative to each other. The bark is blasted off by the high pressure of the water jet which runs as high as 800 to 1400 p.s.i.

There are a number of ingenious ways of carrying out the mechanics of the operation. In one case the log is mounted between centers as in a lathe. In another the log is revolved slowly on knees while the jet of water is moved back and forth along the log at high speed.

In a third type, the log moves through a ring of jets and as this uses a large amount of water and horsepower a modification has been developed whereby the ring contains one or two jets and is made to revolve.

For handling the smaller wood in the East the Streambarker has been developed which is an adaptation of the hydraulic barker as used on the Pacific coast. In the Streambarker the log is passed through the machine on a series of live rolls which cause it to revolve and move forward at the same time under the water jet. Given the right design of nozzle and the right water pressure, this is quite effective. It has the limitation, however, that it requires reasonably straight and round logs. The capacity depends on the size of the logs but 7 to 10 cords per hour is a fair figure. As large logs go through almost as quickly

as small ones, the capacity varies with the size of the log.

Rossers

In the rosser the log is revolved on live rolls and a rotating cutter head is held down against the revolving surface. This method produced a very clean log but even with skilled operation much good wood is removed with the bark. It works best on reasonably straight and round logs. Extensive tests which have been carried out indicate a total loss by volume on a rough cord of 24%. Of this loss 12.75% represents bark. This means that there is an actual wood loss of 11.25%. Two men operating one J & C rosser can average $1^1/_2$ cords per hour.

Williams & Wilson Woodpecker

Woodpeckers are used for gouging out knots, bark seams, and rotten wood. They are a fairly good machine for recovering what perhaps would otherwise be wasted wood. In this machine the log is not revolved automatically but is moved back and forth under a high-speed cutter head. This cutter head can be raised and lowered to any desired position on the log being cleaned. A skilled operator can produce clean logs with comparatively little loss of good wood fiber, but it has the disadvantage that the operation is slow.

Knife Barker

In this operation the log is held against a revolving disk fitted with knives. This type is used chiefly where there is a considerable quantity of large logs which have been sawed into quarters or smaller sections before barking. This operation is also very wasteful on wood. The author has no information on their capacity.

Astrom Barker

The Astrom barker is a Swedish development. So far this machine works on long logs only. The unbarked logs are moved endwise through two revolving disks having chains on springs that are wrapped around the log. The disks are about 5 inches in diameter and are made to revolve at about 275 r.p.m. As the logs move through the machine the bark is rubbed off by the action of the chains. No water is used with this barker and this should considerably improve the value of the waste as fuel.

There is not too much information about this barker in operation. It seems to do a fair job on wood containing knots, but the first 4 inches or so of bark appears to be a problem. Claims varying from 150 to 300 17-foot logs per hour are made for the capacity of the machine.

ARRANGEMENT OF ONTARIO PAPER CO. WOOD ROOM FOR HANDLING BOTH PEELED AND ROUGH WOOD

Figure 1 is a flow diagram of the wood room at Thorold for handling both peeled and rough wood. This wood room handles approximately 700 cords of wood per day and as much as half of this can be

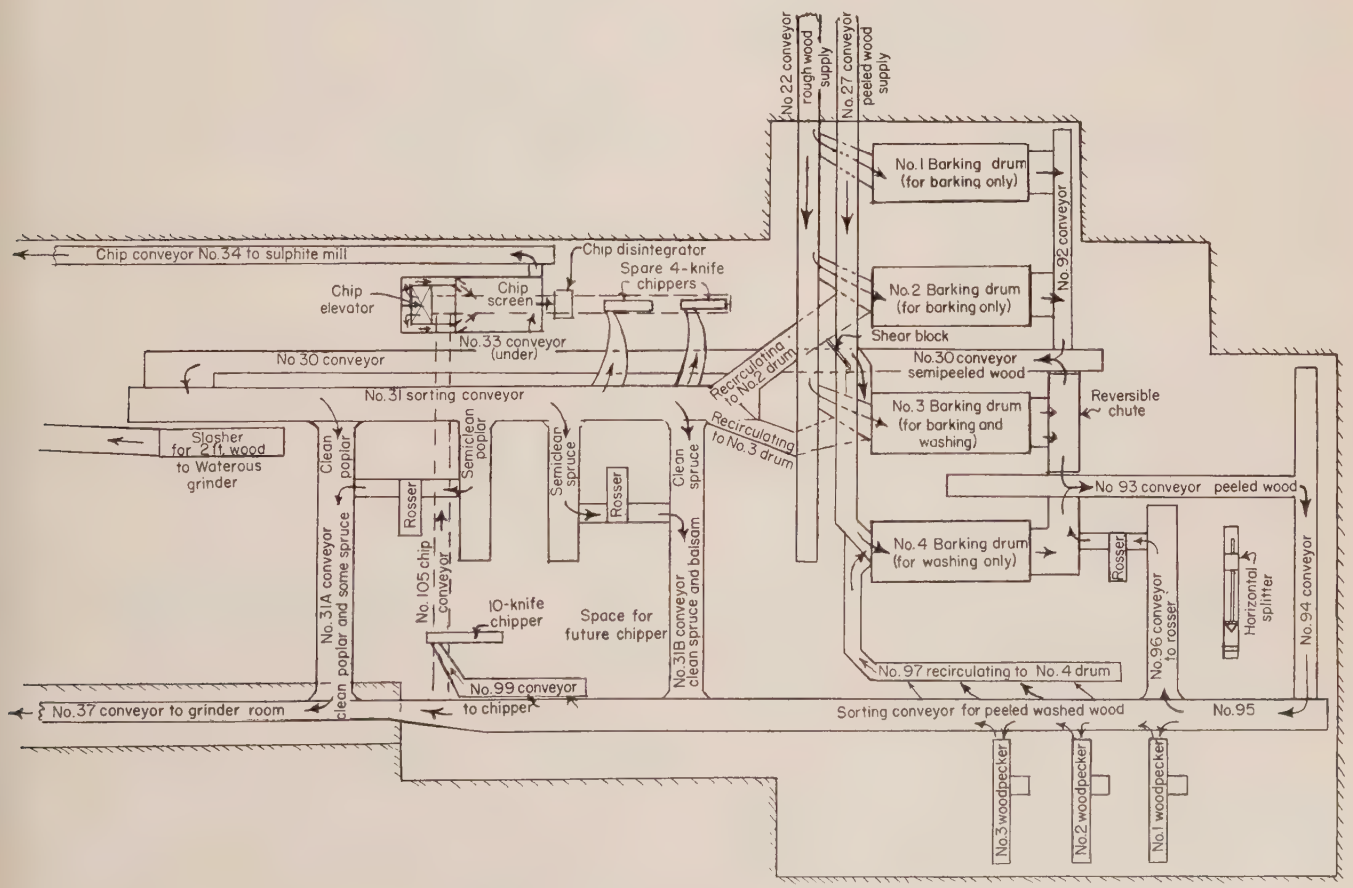

Fig. 1. Flow diagram of woodroom

rough wood. More rough wood is run in the summer months because at that time, barking is easier.

In this wood room there are four 10- by 30-foot barking drums, three J & C rossers, three Williams & Wilson woodpeckers, one wood splitter, one high-speed 10-knife chipper, and two low-speed 4-knife chippers.

Following the wood flow the peeled wood and the rough wood come in on separate conveyors, the wood on No. 27 being peeled and No. 22 rough. The rough wood is diverted to drums Nos. 1 and 2 while the peeled wood goes to Nos. 3 and 4. All the wood from Nos. 1 and 2 is discharged onto conveyor No. 30 which carries it to the sorting conveyor No. 31.

No. 3 barking drum has a reversible chute and the wood can be directed to mix with that from Nos. 1 and 2 or all of it can go to No. 93 conveyor along with that from No. 4 drum.

The wood discharged from conveyor No. 30 passes over a sorting conveyor where men are stationed. At the first station clean wood is taken off and sent over No. 31A conveyor to the grinder room. At stations 2 and 3 wood not clean is put through two J & C rossers. The wood from the first rosser can be sent either to the grinder room or placed back on the sorting conveyor which leads to the sulphite chippers. The wood from the second rosser is sent to the chippers. Any excess of unbarked wood is recirculated through the drums. Wood from Nos. 3 and 4 barking drums is delivered onto Nos. 93, 94, and 95 conveyors. Rough wood may be removed and passed through another J & C rosser for complete cleaning. Any wood that needs minor cleaning around knots and seams is taken off conveyor No. 95 where three woodpeckers are located and the final cleaning before the chipper is performed there. This layout has been found to work very well.

It is pointed out that the amount of wood cleaning necessary is largely dependent on the end use of the pulp. High grade sulphite, for instance, requires very clean wood whereas if the pulp is to be used in wrappers, etc., intensive wood cleaning is not essential.

WOOD MEASURING

Wood which is received in lake boats carrying approximately 1100 cords per cargo is all measured into the stock piles by determining its volume by measurement of an equivalent volume of water. About 125 cargoes are unloaded at the dock during the navigation season. The wood is unloaded mechanically by means of three Mead Morrison cranes equipped with Owen pulpwood grapples.

Wood Volume Measuring Equipment

As the wood is unloaded it is carried by an inclined conveyor to one of two large cages each capable of holding approximately 4 cords of wood. These cages are suspended on steel cables and each is located over a large tank of water. They can be raised or lowered into the tanks.

By noting the rise in water level with the lowering of the loaded cage, the volume of water equivalent to the volume of wood in the cage is determined. That in brief is the method by which the wood volume is obtained.

The two water tanks are $28^3/_4$ feet in height. They are approximately square being about $11^1/_2$ feet on each side. The cage is 10 by 11 feet with a sloping bottom of steel grating. The face of the cage is 20 feet high while the back is $15^1/_2$ feet. The sloping bottom is necessary for the wood to slide out of the cage when it is in the raised or discharging position.

There are no doors on the cages to contend with since the design is such that the cage is loaded in the lowered position and the wood is admitted at the top and back side. In this position the front or discharge side is below the discharge level and inside the water tank. As the cage is raised, the wood discharges onto a conveyor which carries it to the piles and to the plant.

Controls. The operating motors for the cages are housed directly above the tanks. They are equipped with limit switches that automatically stop the motor whenever the cage loading or unloading position is reached.

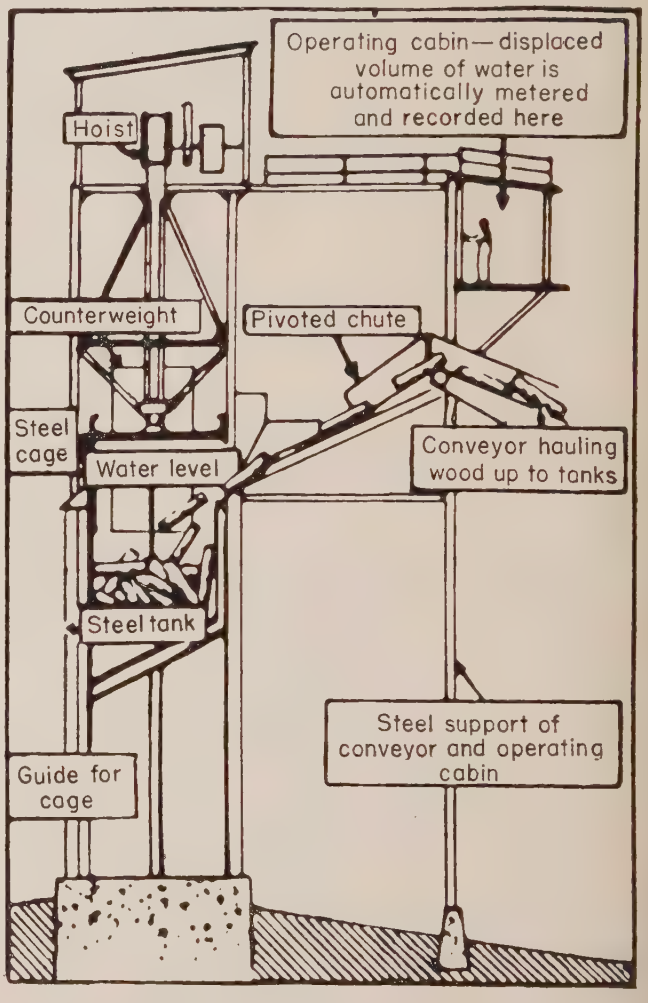

Fig. 2. Cage in loading position

Each tank is equipped with three bubbler-type level recorders. These instruments record separately the following levels: 12 inches below to 12 inches above the zero level; 12 inches below to 60 inches above the zero level, and finally the third meter registers 36 inches above to 60 inches above the zero mark. The first instrument checks the zero level. It has a sensi-

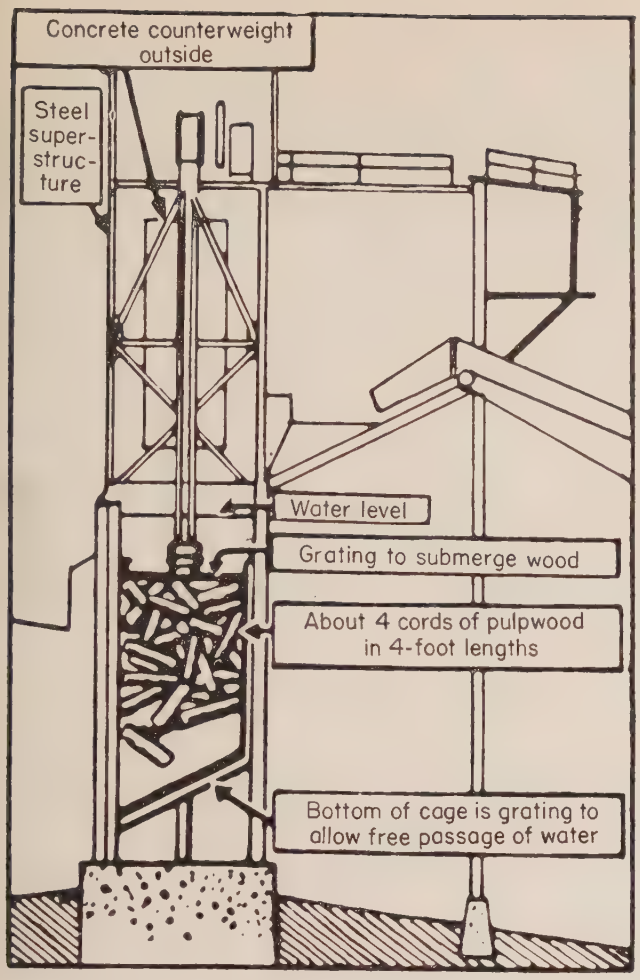
Concrete counterweight outside
Steel superstructure
Water level
Grating to submerge wood
About 4 cords of pulpwood in 4-foot lengths
Bottom of cage is grating to allow free passage of water

Fig. 3. Cage loaded and submerged

tive element with a chart graduated in half-inch divisions. The second recorder measures the whole scale and is only used to check the other two instruments. It is graduated in 2-inch divisions. The third instrument is the one from which final calculations are made. It records the top or active section of the measuring equipment. Actually, it records the top 24 inches of the tank which is of chief concern since the variation from cage to cage is much less than that, being about 2 to 4 inches. The latter chart is graduated in half-inch divisions. It records not only the level to which the water rises as each cage of wood is lowered but the number of cages as well.

In addition to these controls there is a solenoid operated water valve that automatically admits make-up water into the tank to bring the level to zero in preparation for the next charge. This is necessary because of the water carried away on the surface of the wood at each discharge of the cage. When the water level has been brought back to zero a light flashes in the control tower indicating that the original level has been restored and the cage is again ready for filling. This is also indicated on the level recorder.

Calibration. Before using the system it is necessary to establish a calibration curve for the tanks. This is done by actually weighing the quantity of water from zero to a level which will take care of the maximum quantity of wood that can be loaded into the cage. For this purpose the tank is filled with water then drawn off through a valve into a 200-gallon tank located on a scale. The water is drawn off in 2000-pound quantities and a note made of the change in level on the recorders. In this way a calibration curve is obtained showing the cubic feet of water displaced with changes in level.

The cage is immersed separately and a correction for its volume added into the chart.

Operation. On the arrival of a wood boat seven 1-cord racks are placed on the boat deck. These racks have a 4- by 8-foot face with a bar across the top. They are then filled with wood taken at random over the deck. The wood is neatly piled and each rack represents 1 cord of wood. With the system and conveyors clean, these seven racked cords are sent through the wood measuring system and the volume of these seven cords determined. This volume, divided by seven, gives the solid volume per cord and is the cord factor in cubic feet for the cargo.

The regular operation with the cranes is then begun and continued until the cargo is completely unloaded. The total volume in cubic feet for the shipload is then determined from the charts and this volume divided by the volume per cord determined earlier gives the number of cords for the boat.

Figures 2, 3, and 4 show diagrammatically the wood entering the cage, the cage submerged, and finally the cage in the discharging position.

Results. During the past several years, the wood which has a mean diameter of 5.8 to 6.3 inches with an average length of 48 inches averaged 98.5 solid cubic feet per cord.

The results obtained are influenced by the length, diameter straightness of the sticks, and how well the knots are trimmed.

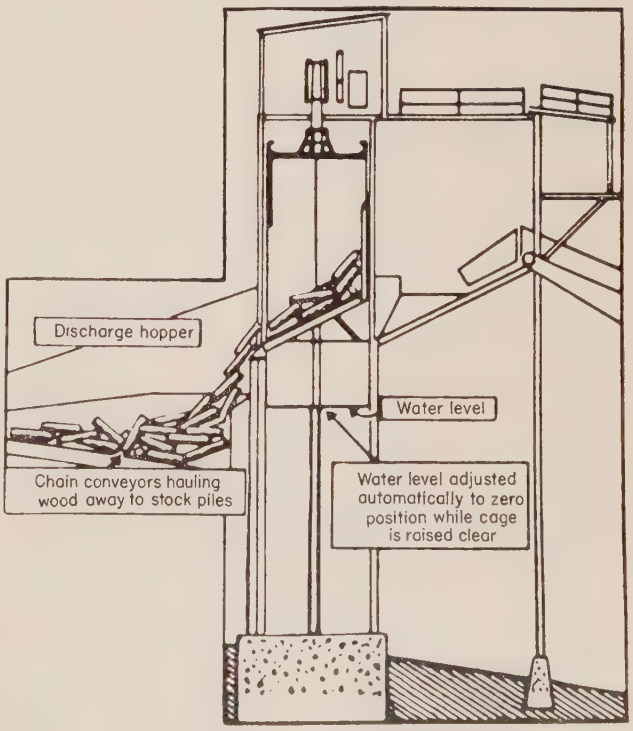
Discharge hopper
Water level
Chain conveyors hauling wood away to stock piles
Water level adjusted automatically to zero position while cage is raised clear

Fig. 4. Cage raised and wood discharging

There is a very small percentage of crooked sticks, and knots are well trimmed. The diameter and length run quite uniform.

The above procedure gives the total quantity of wood received during the navigation season and placed in storage in the yard. It does not give the day-to-day consumption of wood in the process although similar equipment could be used for the purpose. The author's plant manufactures newsprint with integrated sulphite and groundwood mills and the method of writing off the wood is as follows.

The wood consumed in the sulphite process is all weighed over a Merrick weightometer. Chip samples from the conveyor going over this scale are taken every 2 hours and placed in an airtight container. At the end of each shift the moisture and density of these chips are determined. From these determinations and the wood loss as chipper dust which is also known, the number of cords of wood used each day by the sulphite mill is determined. All wood is written off on the basis of 98 solid cubic feet per cord. An example of how this works out is as follows:

	Per day
Weight recorded over scale, lb.	1,163,636
Correction for chipper dust, etc. (2%), lb.	1,186,908
Wood moisture, %	45
Moisture-free wood consumed, lb.	652,800
Wood density, lb.	0.40
Dry weight/cord of 98 cu. ft., lb.	2446
Cords of wood consumed	266.9

The wood consumed in the groundwood plant is worked back from the accepted pulp produced plus the screenings, white water losses, and water-soluble losses. The accepted pulp is all metered. The rejects from the bull screens, second screens, and solids in the white water are measured daily. The water-soluble content of the wood is measured periodically.

The formula worked out for this calculation is as follows:

Wood consumed $= (Tg + Tgs) \times 0.308$
Tg = tons of air dry screened groundwood
Tgs = tons of air dry groundwood screenings (rejects from 2nd screens)
D = wood density
98 = a constant representing the solid volume of 1 cord of wood
One cord of air dry wood in tons equals

$$\frac{D \times 62.4 \times 98}{2000 \times 0.9} \times \frac{D}{0.295}$$

Corrections for tailings, etc.

Bull screen tailings	1.0%
Water solubles	1.5%
White water	1.8%
Total	4.3%

Therefore, the cords of wood used per day are

$$\frac{Tg + Tgs}{0.957 \times D/0.295}$$

$$\frac{(Tg + Tgs)0.308}{D}$$

$$\frac{(400 + 32)0.308}{0.40}$$

410 cords

By these two methods it is possible to keep a day-to-day record of the wood consumed.

Other Methods

Another method in use for the measuring of wood by weight or cords is by means of the Blake-Denison automatic log weigher. This machine is in use in several Canadian mills weighing the wood consumed by the plant as it comes in from the mill yard. The principle of this machine is as follows. A short section of the conveyor is suspended upon a weighing system and as the material passes over, it is weighed in sections of a predetermined length, the length being arranged to suit the speed at which the conveyor is traveling to allow the mechanism to accurately balance the load per section. The weighing is automatic, and the recording device totalizes the amounts weighed.

Companies using this system claim that by proper checking and maintenance, a limit of error of $\pm 1\%$ can be obtained. It has also been found that the most accurate method of determining the cords consumed each day is to weigh a standard cord and use this as the unit weight per cord.

WOOD DENSITY

Before closing this paper the author would like to emphasize the importance of wood density determination. When one is purchasing wood in cords or determining the pulp or paper yields from a cord of wood, the importance of knowing the density of the wood in question is absolutely essential. Obviously, there is very little meaning in comparing the cords of wood consumed per ton of pulp unless the weight of wood fiber in the cord is known. It is rather amazing, however, how often this is overlooked.

Balsam and spruce will vary in density from approximately 0.32 to 0.45. Using a solid volume per cord of 98 cubic foot the dry weight of a cord will vary as follows.

Wood density	*Wood weight per cord in pounds, dry*
0.33	2059
0.36	2246
0.39	2434
0.42	2620
0.45	2808

The cords of wood required to make a ton of groundwood using wood with a density of 0.36 and a per cent yield of accepted pulp of 90, would be 0.99 cord per ton of pulp. On the same yield basis and using wood with a density of 0.42, only 0.85 cord per ton would be used. This is a difference of 0.14 cord per ton which at $25 per cord would mean $3.50 per ton of pulp, a substantial cost decrease with the higher density.

The same thing applies when purchasing pulpwood by the cord. If a cord of wood with a density of 0.42 sells at $25, then on the basis of dry wood weight, a cord of wood at 0.36 density has only a value of $21.43. This is a difference of $3.57 per cord of wood.

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Centralized Transportation System for a Pulp and Paper Mill

G. L. HAWKINS

Electric trucks and a centralized transportation control can be used to advantage in the pulp and paper industry, but as to whether or not they can be used successfully, depends to a large degree on the design and layout of the plant. Consideration must be given to the condition of the floors, widths of aisles and doorways, distances, building locations, types of materials handled, etc. The type and design of the transporting unit are dependent on the service to which it is to be applied. Considerable savings in labor can be effected; citing the experiences of his company the author indicated a saving of about 40% in direct labor for warehousing and shipping operations. Because of the large number of trucks in use, it was considered advisable to set up a transportation system at the author's mill, which is charged with the maintenance and distribution of all carrying units. This permits adequate servicing of all departments since trucks can be assigned to those points where their use is essential. Otherwise, there may be locations in which equipment is idle while, in others, the need for it is urgent.

Electric trucks and centralized transportation control can be used to advantage in the pulp and paper industry. This statement is made for the benefit of those plants who are considering this problem today. Information about the merits of electric trucks and centralized control is not abundant but fundamental facts and several case histories are available.

The intent of this discussion is not to extol the merits of electric trucks and centralized control. Its purpose is to review the experiences of one company and to describe how some problems were solved, thereby effecting savings in man power, decreasing operating costs, and reducing physical effort on the part of mill employees.

However, the question of whether or not electric trucks and centralized control can be successfully used inside a plant depends to a large degree on the design and layout of plant. Transportation plans must be based on the conditions within the plant. Consideration must be given to height between floors, type and condition of floors, width of aisles and doorways, distance of truck travel, location of buildings, whether closely grouped or scattered, type of roadways between scattered buildings, type and variety of materials to be handled and stored, plus many other factors which enter the picture before a justification for the purchase of equipment and the formation of a centralized transportation system can be established. Fundamental questions as: (1) will electric trucks reduce man-hours of operation, eliminate heavy manual work, and decrease operating costs, and (2) will centralized control prevent surplus of equipment, render greater service, eliminate waste efforts, reduce confusion and friction between departments, must be first thoroughly considered; otherwise a true overall picture will not be obtained.

The first electric truck was purchased in 1924, and the year 1944 saw the formation of the centralized transportation system.

The intervening years saw a substantial increase in the number of electric trucks and their service developed to greater use in the handling and transportation of materials within the plant on a wide variety of applications.

In 1924, annual production was approximately 81 million pounds of paper; in 1944, the year centralized transportation went into effect, annual production was about 150 million pounds and in 1948, the annual production is expected to reach 200 million pounds consisting of some 4000 items of paper which must be handled in process, stored, and shipped to customer.

GROWTH OF ELECTRIC TRUCKING

As previously stated, the use of electric trucks started in 1924 when it was found advisable to purchase a 6000-pound capacity high-lift platform truck for handling and storing baled broke at the broke beater. The truck proved to be a valuable implement by which operators were able to better store the bales of broke, thereby saving valuable floor space and also reducing the labor involved in that operation.

This truck was also used for numerous other miscellaneous applications of materials handling such as moving heavy machinery. The results obtained from the use of the truck were most gratifying and its use justified.

Loading Beaters

The next purchase of electric trucks came in 1927 when the dewatering plant was built to produce noodle pulp at 20% moisture-free consistency. Up to that time beaters were charged by hand with lapped pulp. Three 4000-pound capacity high-lift, tilting platform electric trucks with separate dump bodies were purchased. Each dump body held 65 cubic feet of noodle pulp. The truck picked up a filled body of pulp at the dewatering plant, carried it to the beaters, dumped, and returned for repeat operations. This was a big step in the right direction because the cost for filling beaters was reduced and the entire pulp-handling job in the beater room was made much easier.

G. L. Hawkins, Materials Handling Engineer, Hammermill Paper Co., Erie, Pa.

To give some idea of the savings effected through the use of electric trucks in furnishing beaters, it previously had required four men for each set of beaters per shift, or a total of 72 men to fill beaters for six paper machines. It now requires two men for each set of beaters per shift or a total of 42 men to fill beaters for seven paper machines. This was a labor reduction of 50% excluding the two truck operators per shift.

Handling Pulp and Paper

The next truck was purchased in 1929. This was a 4000-pound capacity roll-handling truck for use in transporting large heavy rolls of paper from a distant paper machine winder to the finishing room cutters. Later a similar truck was added to carry rolls from the other paper machine winders. The operation of both trucks was the same.

Up to this point all of the trucks had been of the platform type and their use was special and more or less confined to a very definite operation. However, in all cases, sizable savings were made not only in handling costs but also the jobs on which trucks were used were made many times easier.

In 1935 a high-lift, tilting, tiering electric fork truck was purchased for use at the wet machines in the handling, transporting, storage, and reclaiming of lapped pulp.

Previously, all pulp produced on the wet machines in lapped form was hand trucked either to the beater room or storage. In the case of storage, the pulp was hand piled to a height of approximately 12 feet. When it became necessary to remove the pulp from storage, it was again handled by hand and manually trucked to the beater room.

The purchase of the electric fork truck permitted the handling, transportation, storage, and reclaiming of lapped pulp to be done in unit loads on pallets. The truck greatly reduced the man power required in the area, made the job much easier, and again labor costs were reduced.

Under the old system, 30 men were required to transport, store, reclaim, and deliver approximately 100 tons of lapped pulp to the beater room in 24 hours, whereas under the present system, only nine men are required. A direct labor savings of 70% was effected through the use of one electric truck.

The installation of a new paper warehouse in 1939 required longer hauls of large skid loads of carton-packed paper to and from storage and shipping. A special low-lift platform truck proved to be the most suitable means of handling these heavy loads and has worked out satisfactorily.

Use of Pallets

During 1941 another high-lift electric fork truck intended for use in storage and warehousing was purchased in order to reduce the heavy labor involved in handling the large skid loads of packed cartons and bulk paper. However, from 1941 to 1943 the truck was used exclusively at the wet machines in conjunction with the original truck assigned to that area. The reason being that the new truck was more versatile at the wet machines than the old one, and consequently, it was used there while the old truck remained idle a good part of the time. This illustrates what happens when there is no single authority governing the use of trucks to place them in locations where they are most needed and better fitted.

The new truck was finally removed from the wet machine because full-time operation of both trucks in that area was not required. It was dispatched to the storage and shipping area to handle the materials in those departments as originally planned. Trials were made on the piling and transporting of the packaged cartons, skid loads of paper, cardboard, carton flats, wrapper, etc., in unit loads on pallets. The results were amazing because less space was required for storage and the materials were handled faster and with much less labor.

Baled Pulp

Another example of how electric trucks reduced costs is in the handling of incoming bales of purchased pulp. Formerly, it took seven men seven hours to unload, weigh, and store a boxcar load of pulp using hand truck methods. With the first use of electric trucks two men plus the truck operator did the same operation in a maximum of 3 hours thus reducing the time by 26 man-hours. Today, by what is believed to be an even better application of equipment, the same boxcar load of baled pulp is unloaded by one man plus the truck operator in $1^1/_2$ hours, a total reduction of 32 man-hours over the hand truck method.

The engineering department, not being satisfied with the results already obtained through the use of electric trucks, continued to study the problem to determine further uses for them throughout the mill in general and thereby to handle materials not only easier and quicker, but at a lower cost. The result of the study clearly indicated the necessity of using additional electric trucks for handling product in process, storage, and shipping.

This study and recommendation coincided with the passage of regulations by WPB restricting the purchase of new electric trucks except for use in vital war industries. However, two used platform trucks were obtained which helped out temporarily although they did not exactly fit the requirements. Nevertheless, some use was made of the trucks in transporting skid loads of paper and some savings were made. However, the case is cited to illustrate the point that careful study should always be made so that the truck fits the job and vice versa.

In the early part of 1944 the problem of producing a special sheet of paper for use in the war effort was faced. This problem involved the handling of pulp obtained from outside suppliers and delivered to our plant in large heavy skid loads by boxcar. The pulp had to be unloaded, weighed, stored, and transported to the point of process. After processing, the paper came off the paper machines in rolls measuring 123 inches in width, 21 inches diameter, each roll weighing approximately 1000 pounds. The rolls had to be properly wrapped and loaded in boxcars for shipment.

This presented an entirely new problem, and it was solved by the proper use of electric trucks.

Special Designing

Permission was granted to purchase three new 4000-pound capacity, tilting, tiering, telescoping, fork trucks. All three trucks were identical and so designed and arranged that the forks could be removed and an extended boom arrangement attached which would handle the large rolls of paper and place them in boxcars for shipment.

The reason for making all three trucks the same was that any one truck could be used on all operations whether handling skid loads of pulp or the finished roll of paper.

The above-mentioned arrangement for handling the rolls of paper was a result of the company's own design. It consisted of a semiautomatic grab attachment pivoted at the end of the boom some 6 feet from the face plate of the truck. It permitted the grab and roll of paper to swing in a complete circle.

The entire arrangement for handling the rolls of paper in the described manner worked out very satisfactorily and required the services of only one man in addition to the electric truck and operator.

The following comparison illustrates the effect on cost by the use of properly designed equipment. When these rolls of paper were first loaded for shipment by hand, the costs were 22.8 units per roll. Later, an improvised electric platform truck cut the costs to 20.4 units per roll, a 10% reduction. Finally, with the high-lift fork truck and boom arrangement just described, the costs were further reduced to 13.1 units per roll, almost a 75% reduction over hand loading. (One hundred units equals $1.08.)

The next experience with electric trucks was with the type commonly known as the motorized hand truck. It was apparent that such trucks had great possibilities in handling the long distance hauls of paper from the main finishing room to case and carton packing operations, converting, and auxiliary manufacture.

The purchase of two motorized hand trucks, rated 4000-pounds capacity each, showed immediate benefits besides making the job many times easier.

A comparison of manual hand trucking versus electric hand trucking shows that it required two, and sometimes three, men to handle the same load of paper as could be handled by one man and an electric truck.

Tractor Trains

By 1946 warehouse facilities were found to be inadequate to meet increased production demands. Detailed investigations indicated that electric tractor trains should be added to the equipment already in use in order to more economically facilitate the hauling, storing, reclaiming, and shipment of product.

These pallet bearing, tractor trains bring loads into the warehouse from the production department and spot individual trailers near assigned storage areas.

A fleet of high lift fork trucks pick the palletized loads from the trailers and tier them in assigned locations. The individual loads average approximately 1600 pounds each.

In the case of flat stock which is not packaged, the loads are skidded with a headboard strapped to the top to permit tiering.

The tractor hauls three trailers. After delivery of loaded trailers, the tractor picks up the empty trailers on the return trip to the production department.

Fork trucks are used in order filling. Full or part pallet loads are taken from storage space and transported to the order assembly area.

The entire system is now in complete operation and works most satisfactorily. It is ideal for the author's mill's operations and substantial savings have been effected over any previous system.

As an example of the savings made in the loading of paper into railroad cars and motor trucks for shipment; ten men now do the job which formerly required 18. Thus, in loading only, there has been a reduction in labor of approximately 45%. Not only is the job made many times easier but more tonnage is handled in the same amount of time.

The over-all savings of the warehousing and shipping operations since the adoption of the new method for handling finished paper as described has been conservatively placed at 40% in direct labor.

The savings mentioned above are not net savings for the reason no allowance has been made for maintenance, operation, fixed changes, etc., but allowing for these, the records do show a substantial savings.

CENTRALIZED TRANSPORTATION

The relatively large number of electric trucks throughout the plant, the rapid development in their use, and the possibility of additional applications, initiated a more intensified study of transportation and materials handling.

The result of the study indicated the need for centralized transportation. In 1944 a separate department was formed on a 6 months' temporary basis with an engineer in charge. At the end of the 6 months' period the entire subject was reviewed, and the result was unanimous agreement that the temporary transportation department should become permanent. This illustrates the soundness of the policy that engineering problems such as these must be thoroughly analyzed and studied in order not only to determine costs but saving before making permanent recommendations and changes.

Superintendent of Transportation

The superintendent of transportation was charged with the responsibility of supervision and control of all electric trucking and storage battery charging within the plant. His duties were to load and unload all materials leaving or entering the plant except wood, bulk materials, machinery or equipment, and to transport, store, and reclaim all materials and items used in the manufacture of paper and shipment of product.

Since the transportation department was formed it has been assigned all gasoline motor trucks and companion equipment that are used at the plant. In addition to all previously listed duties, the superintendent of transportation is therefore charged with all yard clean-up, handling of waste materials, transportation of construction materials from storage areas to points of use, picking up and delivering all materials and equipment from local plants, stores, and warehouses.

The personnel of the transportation department at the present time consists of:

1 superintendent
2 foremen
3 shift supervisors
1 dispatcher
49 electric truck operators
3 storage battery charging attendants
1 storage battery repair man
13 gasoline motor truck operators
15 utility materials handling men

The equipment controlled is:

25 large electric trucks
15 hand electric trucks
2 electric tractors
24 trailers
90 electric storage batteries
6 multicircuit, main storage battery charging units
8 motor trucks
7 service cars
4 highway trailers

There are approximately 12,000 pallets in use at the present time.

The valuation of all inside equipment is approximately $350,000.

The valuation of all outside equipment is approximately $55,000 or a total valuation of all equipment both inside and outside the plant of about $405,000.

Maintenance

The repairs and lubrication of all electric storage battery and companion equipment is done by the maintenance department which operates a shop for such work alongside the battery charging and repair station. Two maintenance men cover the 7 to 3:30 day shift and one man the 3:30 to 12:00 midnight shift. The repair shop is equipped with an overhead crane and elevating grease rack. Cost records are kept on all equipment, and the means for replacement of equipment are being set up as determined by established depreciation values. Thus as a piece of equipment depreciates year by year, funds will be set aside in the annual budget to cover replacement before the time-maintenance cost becomes excessive.

The recharging of the electric storage batteries is done by three men, one working each shift. Their duty is to maintain the batteries in properly charged condition at all times. Daily reports are made on the condition of a battery when it is removed from a truck for recharging. Also the report lists any repairs made to it, time the battery went on charge, charge rate, time it was removed from charge, what truck it goes into, and all other information pertaining to the battery so that a complete and accurate record is kept at all times on all batteries.

There is also one battery repair man who works the day shift. His duty is to clean and repair all batteries, replace cell jars, covers, separators, etc., as required.

Dispatch System

The transportation department operates under a dispatch system; that is, requests for additional equipment, movement of materials, etc., other than standard normal operations, are made to the transportation department office which in turn issues the orders to fulfill the request. Trucking time is accounted for and charges made against the department serviced. This system works out quite satisfactorily, but as always, there is still opportunity for improvement.

CONCLUSION

In conclusion, electric trucks have played an important part in the solution of our transportation and materials-handling problems. They are being used in the shipment of pulp and paper in all forms. All cardboard, carton flats, and wrapper are now received from suppliers in palletized unit loads. These are unloaded, stored, and reclaimed by electric fork trucks. All bagged materials such as powdered alum, clay, talc, etc., are also handled in palletized unit loads by electric trucks. In all cases, electric trucks have made work easier, moved materials faster and, at the same time, made substantial savings in man power and operating costs.

It is believed that a centralized transportation department is not only important but necessary in the larger plants today.

It is also believed that a single authority and undivided responsibility in the operation of electric trucks and the movement of material is essential. Without the unity of centralization, each department has its own equipment. One department might be struggling along with inadequate equipment due to increase in materials to be handled, or breakdown of equipment, while other departments might have a surplus of equipment due to a decrease in materials to be handled. Obviously, the various departments are not operating economically.

Further, it might be possible that other departments try to obtain more equipment than required for a margin of safety. This affects the interest of the whole organization, the equipment available, and the capital investments that already have been made.

Centralization of control renders greater service at a minimum of expense. It eliminates waste effort and confusion and provides proper priority to important work.

The materials-handling costs for the pulp and paper industry in general are probably not known. It is quite possible such information is not available but it can be imagined that the figure is high. The interior plant materials-handling and transportation costs for the year 1947 were approximately $4^1/_2\%$ of the total manufacturing costs of the author's mill which is sufficient to justify thoughtful consideration of methods.

New materials-handling and transportation problems are continually arising within the plant. These problems must be solved and savings effected wherever possible. Some of these problems will require additional electric trucks. In any event it is believed that both now, and in the future, work must be made easier, operating costs reduced, and movement of material made faster if the ever-changing conditions are met and there is every reason to believe that there will be a greater need and use for electric trucks within the plant not only during the coming year but in years to come.

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Trends in the Manufacture of Groundwood

HENRY J. PERRY

The shortage of preferred wood species, higher costs of operation, replacement costs, and obsolescence as they affect mechanical pulping operations are discussed. The present state of equipment and operations as indicated by the TAPPI survey on groundwood pulping equipment and the future possibilities of the industry are considered.

THE groundwood pulp industry, in common with all other industries, is faced with many problems. Of them all, there are two which appear to be most pressing. They are: (1) a shortage of preferred species of wood; and (2) high operating and replacement costs, low depreciation rates, and obsolescence. These problems have been discussed for years; now something must be done about them.

For a moment let us ask ourselves, Why are we in business? The only answer is to make money. That we choose to do it by making groundwood is unimportant. Our economy is based on plenty; in order to be successful, therefore, the product must be made at the lowest unit cost giving to investors a fair return for the risk involved, to labor a fair wage for fair effort, and to management and operators a fair income for the ability to combine capital and labor and make them produce.

With this in mind, the problems can be examined for possible solutions. That the answers may be hard to find, there is no doubt; that they will be found, there is also no doubt. With the courage, inventiveness, and ability of the operators, nothing should prove too difficult. Perhaps the hardest part of the task will be the overcoming of their inertia.

WOOD SHORTAGE

The first problem to consider is the shortage of wood. Most are accustomed to thinking in terms of plenty: plenty of wood, labor, and water, a great plenty of available production capacity, and, still more recently, a greater plenty of eager customers ready and willing to pay fantastic prices for almost anything that would hold together long enough to be printed. None believe that this last condition will or can continue indefinitely.

The era of plenty of wood has come to a close; nowhere on this continent are there abundant supplies of the preferred species. Not even in the South does there exist an abundance of pine with which to meet the ever-growing demand. Therefore, the thinking and processes must be adapted to the less desirable species such as poplar, maple, and birch in the North, the gums and other hardwoods in the South.

HENRY J. PERRY, Member TAPPI; Consultant, New York, N. Y.

A great deal has been written and said about the shortage of preferred species and where the blame rests; however, past history is of little importance except to show the way to others that they may not repeat our mistakes. The remaining stands of preferred species must not only be conserved but the methods to use the woods which are more abundant must be developed and adapted. When this is done, more efficient utilization will repay well for the effort. Many plans for better utilization have been proposed but, today, the best and most promising is the sustained yield woods management plan.

Just what does this mean? The plan, in simple terms, means that no longer will a forest area be allowed to grow as Nature lets it; it will, instead, be intensively farmed by the most advanced methods known to silviculture. Trees may be planted or allowances made for natural reseeding, areas will be thinned or weeded, and the harvest will be sold or allotted to those industries best able to utilize the wood to maximum advantage. No longer will prime saw logs go to the pulp mills.

As an indication of the things to come, witness the Kennedy report and the Forest Practice Act of New York State. Under these plans and practices, pulp producers will receive thinnings from the young growing areas and the nonsaw log wood from the more mature stands.

This question must be asked: Is every stick of wood used to maximum advantage? If not, why not?

COSTS

The second problem is the cost of wood, labor, power, and high replacement, low depreciation rates, and obsolescence. Most operators are decidedly cost conscious because this problem must be considered in one form or another every day. Some increases have come from inflation and taxes, over which there is little control; others have sprung from practices carried on for many years and which now add considerably to operating costs.

For example, consider a plant which operates two groundwood mills. One is a relatively modern, electrically driven mill. Its wood costs per ton of groundwood have increased from \$5.94 in 1940 to \$17.41 in 1946; labor has risen from \$1.46 per ton to \$2.98; and the total cost per ton has jumped from \$13.91 to \$27.86.

The other groundwood mill, a waterpower plant, is worn out and obsolete. The wood costs increased from \$7.33 to \$15.97, labor from \$2.46 to \$4.89, and the total from \$19.89 to \$29.41. Inasmuch as this mill must lap its production, the cost for this must be added.

It was $4.59 in 1940 and $8.28 in 1946. Thus, a paper mill groundwood cost of $27.86 for the modern mill and $37.69 for the obsolete mill shows a difference of about $10 per ton—a heavy penalty to pay for obsolescence.

These cost differences arise from increases in wood and labor and the inability to modernize. What can be done about it? Because wood prices are set by demand and labor rates by industry negotiation, the obvious answer is to replace the obsolete equipment and methods. Unfortunately, depreciation rates were set on prices when this mill was built over 35 years ago and the equipment price index was less than 59. Today's index is over 144, so that reserves do not come anywhere near covering the cost of replacement.

Some will say that many obsolete plants have been depreciated several times over; in some instances, this may be true. This, however, is of little consolation to the present operators.

Fortunately, there are at present available profits which more than cover the additional expense, but this adds a further consideration; stockholders, who have not had a dividend in some time, feel that they are entitled to make up for the lost returns. The choice then comes down to this: Shall profits be foregone in these good times in order to weather future economic storms, or shall the profit be taken now and let the future take care of itself?

Another question, therefore, is: Where can operations be improved so that the needed improvements can be financed and paid for in two years, a term within which bankers or other financial people would require the amortization of the debt? As a suggestion, analyze costs in more detail than ever before; approach the mill with this viewpoint:

1. Is every stick of wood yielding the maximum amount of fiber?
2. Is every man-hour producing effectively?
3. Is every kilowatt producing efficiently?

There may be an agreeable surprise at the opportunities for savings.

PRESENT EQUIPMENT AND METHODS

What is the present status of groundwood pulping equipment and methods which, in part, are causing these high costs?

Wood Preparation

There has been no radical change in pulpwood preparation for some time; the barking drum is still the most common machine in use.

Just prior to and during the war, when hand-peeled wood was no longer available, considerable excitement was aroused by hydraulic barking methods. Barkers of this type are doing a wonderful job on the West Coast. At the present time, however, it may safely be said that, on the small diameter Eastern wood, the results are not too encouraging; the capacity is low, even with an efficiency of about 85%. There is some promise in the new chain type barkers; these units, when improved and strengthened, may be the answer to small operations in the woods on 4-foot lengths.

Conveying

The use of rubber belt conveyors in place of the usual cable conveyors, flumes, etc., is the most important advance in this line of equipment. Belts appear to be safer, quieter, and easier to maintain.

Grinding

Grinders. According to the recently issued TAPPI survey, grinders apparently last indefinitely. There are 370 three-pocket grinders still in operation; three mills have installations of over 31 grinders each, twelve mills have from 10 to 30 grinders each, and the balance have from 1 to 8 each. The appalling thing is that most of the grinders are over 30 years old. In the magazine grinder field, most of the chain feed and hydraulic magazine types are 16 to 20 years old.

The logical question to ask is: Which is the best grinder? There is none, because there is no standard condition by which to judge. It is possible, however, to draw some conclusions.

1. For small tonnages, the 3-pocket grinder is hard to beat when considering first cost, floor space, and power consumption.
2. For larger tonnages, the Roberts has many attractive features for modernization purposes and wherever 5-foot wood is used.
3. The Great Northern competes in many ways with the Roberts.
4. For the large installations of 200 daily tons or more, either the hydraulic or chain feed magazine types are preferred. Actually, the hydraulic magazine seems to be more often chosen, probably on a basis of first cost.

It is therefore apparent that, before choosing the proper grinder, all factors affecting the operation must be known and carefully weighed.

Stones. Artificial stones have almost completely replaced the natural type, although a few mills still use them for control purposes. The life of an artificial stone is reported to run from 10,000 to 60,000 cords, depending on grit and hardness, while natural stones average about 1200 cords.

Temperature. In larger mills, temperatures are closely controlled; in the North, with a closed system, a temperature of 190°F. is not uncommon, while southern operators often run at 205°F. Some mills are using accurate pH control. The combination of high temperature and low pH helps to overcome pitch trouble.

Pressure. Most pocket grinders have Myers regulators installed, with inlet pressures varying from 60 to 160 pounds and pocket pressures from 48 to 100 pounds. Little can be done to increase pressures on present installations because most grinders are running up to full load. The trend is toward higher pressures and larger motors on new installations. This is especially advisable as the use of hardwood becomes more common.

Speed. Present installations range from 2800 to 3900 f.p.m., based on safe operating speeds for natural stones. New installations should be designed to run 5000 f.p.m.; the extra strength of artificial stones makes this possible.

Grinder Production. The production of 3-pocket grinders varies from 3 to 20 tons per 24 hours. Some

of this variation is due to the different grades produced; however, in comparing two mills reporting in the TAPPI survey, each making the same grade, the results show that one mill produces 6 tons while the other makes 11 to 12 tons. The freeness is practically equal, but there is a difference of 23 hp. per ton.

In magazine grinders, there is also considerable variation when using the same type of grinder and making the same grade; one mill reported making 20 tons, while the other made 24 tons. There is little mechanical difference, and yet the horsepower on the first grinder is 61 and on the second, 71. It therefore seems that there is room for improvement in grinding techniques.

Burrs. The spiral burr is by far the most popular. This type ranges from 8 to 12-cut by $^3/_4$ to 5-inch lead. Almost every grade of pulp is made with this type of burr and, therefore, it would seem that burr characteristics are not too important.

Screening

Bull Screens. Most bull screens in use today are home-made, and the preference seems to be for the inclined perforated plate type. The Jonsson or vibrating plate type, however, is being used with great success in replacement programs or in new mills. It is suggested that, if an inclined type is used, the rejects be carefully checked as this is a place where hidden losses can easily occur.

Coarse Screens. Rotary screens are divided into two classes: those with high-speed impellers and those with slow speeds. The main difference between the two is that the slow speed screens have coarser plates. There appears to be a definite trend away from coarse screens which results in a saving in power. As an example, the horsepower consumption varies from 0.5 to 10 hp. per ton.

Fine Screens. Rotary fine screens have replaced flat screens except in a few instances where the latter are used on tailings. The Quiller is still the most commonly used; the Cowan, however, is being installed as a replacement. Its main advantages appear to be large capacity, low power consumption, and ability to operate at higher than normal consistency.

Grit Removal Systems. Now that artificial stones are being used, rifflers do not seem to be necessary as the amount of grit has been so greatly reduced.

Reject Refining

In general, mills producing 3 tons or more of rejects have installed refining equipment. The average news mill holds its rejects to 3 to 5% and has sufficient quantity to make refining a standard practice.

The smaller mills, as a general rule, do not refine, although some report rejects as high as 24%. Because standard refining equipment is too costly, many of the smaller mills are installing high-speed, abrasive-filled jordans. The capital costs are much lower and, with wood at 30 to $40 per cord, it takes very little time to pay for the installation and make a handsome profit as well.

Thickening

Thickening presents no particular problem to the majority of mills. The elimination of a couch roll to increase wire life is definitely desirable. The newest thickening device on the market is the Zenith Pulp Press, which will deliver pulp at 38 to 42% moisture-free. It has several applications for high density peroxide bleaching, loose storage, and possibly the elimination of laps for market pulp.

Wet Machines

Wet machines are well known to all of us and need no comment.

Save-alls

Few mills have save-alls in their groundwood systems. Of those that have, the home-made side hill type is the most widely used. While it is advisable to have a closed system or to balance the use of white water with the paper mill, a save-all should be used for all mill effluent before discharge to waste as an additional precaution against loss.

Water Supply

Water treatment other than by chlorination is rather uncommon in groundwood mills. The survey shows that many mills do not conserve the use of water within their systems. Fresh water consumption is reported to vary from 1000 to 50,000 gallons per ton. This would indicate that each mill should give more thought to white water reuse and to streamlining its flow.

Piping

As might be expected, a majority of older mills are using iron or wooden pipe. The newer mills, and those with replacement programs, are using copper tubing, Transite, or steel with Lithcote linings. Each type has certain advantages and, of course, disadvantages, so that the choice must be made only after all conditions are known.

Consistency Control

Trimbey regulators are the most common, followed by DeZurik, Poirier, and Bird. These control devices appear to be satisfactory when agitation is good.

Slime Control

Slime control is an individual mill problem. It occurs in varying severity due to the season, stock temperatures, general housekeeping conditions, and other factors. Chlorine, chloramine, chlorinated phenols, and mercuric compounds, singly or in mixture, appear to be satisfactory as controls. One mill reports the use of Blancol and another of Dicalite as slime preventives.

To date there has been too much mystery in slime control and the compounds used. Any program, to be successful, must take into consideration good housekeeping, outside of the system as well as inside. Dead ends must be eliminated, and the flow must be streamlined. Fresh water and wood must be as free from contamination as possible. Then and only then can the bactericides and fungicides really do a good job. Experience has shown that the load and cultures change and that immunity develops; thus, no one treatment or dosage will work effectively at all times.

While it is desirable to make a chemical, rather than a bacteriological, problem out of this nuisance,

those mills with bacteriological assistance and equipment certainly have the advantage over those which approach the problem from a purely chemical viewpoint.

Measurement of Groundwood Production

Practically every mill measures the wood delivered to the grinder room as a production control. The most commonly used method is by racking which is the hard, laborious way. Several mills at frequent intervals count the sticks and check the number of sticks per cord.

Stock Metering to Paper Mill

As might be expected, the news mills meter the groundwood and sulphite to the paper machines, generally using a Trimbey meter. The smaller mills judge the amounts of groundwood used by the number of laps furnished or volume run into the beaters. Several use more complex methods; one uses the chlorine number of the finished paper, another, paper produced less chemical pulp and machine losses, while still others use regulating chests. Altogether, there are nearly as many systems as mills, and many of the methods must be subject to considerable error and time lag.

It would seem that here is a very definite place where savings can be instituted. Any system of measurement based on paper analysis, regardless of its technical excellence, is certainly subject to wide variation.

In looking to the future, certain possibilities should be considered now.

Pretreatments

Ever since groundwood was first made, the pretreatment of logs has been practiced. Marshall in 1870 boiled and steamed logs in order to increase the strength so they would more closely approach chemical pulps. Fish developed his process and enthusiastically proclaimed 100% groundwood newsprint. Decker advanced his acid pretreatment method, which was used for some years before it was abandoned. In the South, logs were heated before grinding to make the first southern pine newsprint. All of these methods increased the strength of groundwood and also imparted other valuable properties. That they failed, can be attributed to several reasons: (1) the color was degraded from the light shades we are accustomed to, and (2) most of the treatments were done in poorly adapted equipment with little or no thought to materials of construction or efficiency.

Considering the hardwood problem it is found that pretreatments are again coming to the fore. The reagents basically follow the neutral sulphite method but are coupled with the groundwood bleaching methods. The mistakes of our predecessors of trying to work with makeshift equipment, without regard to materials of construction or natural flow should not be repeated; also, one should not be led astray by tradition. Consider for a moment that chips are easier than logs to treat chemically and to handle. It is possible, from a capital cost standpoint, that the chemico-mechanical processes, such as semichemical neutral sulphite, are cheaper to build and maintain than the combination pretreatment-grinder plants, especially if a hydroelectric plant has to be included. Operating costs may also be equal, especially in areas of high labor and power rates.

Selective Screening and Refining

The selective screening and refining method of making groundwood has been advocated by many but practiced by few, and it deserves much more consideration than it has had heretofore. Now that hardwoods must fill a large part of the raw material supply, consideration should be given to grinding to 25 to 40% primary and secondary rejects instead of 3 to 5%, and refining these rejects to usable pulp without wasting power and wood in making flour. Power consumption may prove to be lower than that now used on hardwoods.

At the present time such a setup is ideal for a market pulp mill, which can sell the coarser fractions to a board mill, the medium fractions for book and specialties, and the fine fractions for tissue.

This method should be given some action. Many will say that the present refiners cannot do a satisfactory job from the standpoint of quality; however, refiner development is not static, and new ideas are being brought out quite rapidly.

Grinder Treatments

A logical place to treat groundwood chemically is in the grinders and yet very little is being practiced or being reported in the literature. The U. S. Patent Office has on file only two patents: the Shearer peroxide bleaching patent and the Great Western Chemical zinc hydrosulphite bleaching patent; beyond these the field appears to be open. The Russians some years ago told of work on the use of alkaline solutions in grinding; according to their reports, the results looked promising. And maybe they can be believed.

Here, again, is a blank spot in present knowledge which needs to be filled in.

SUMMARY

Mills are faced with having to use wood which once was considered undesirable and which will require new treatments and techniques. The "Spruce Psychology" should be buried now and the problem approached with a fresh viewpoint.

Also, costs are high in comparison to those of past experience. Cost reduction is possible, and it is up to the operators to explore every avenue of attack and then carry it through.

There is also the problem, in many instances, of worn-out or obsolete equipment. A plan should be made for each mill so that orderly improvements can be carried through with the least possible expenditure. Groundwood can be raised from its present orphaned state to its rightful place as the best printing, most plentiful, and least expensive of all pulps made.

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The Chemical Nature of Lignin

HOLGER ERDTMAN

At the present time lignin is considered to be a naturally occurring phenolic plastic which, together with cellulose, forms wood. A review of the chemistry of lignin, illustrated by formulas, is given.

In the last 75 years, thousands of low molecular, crystalline, naturally occurring substances have been structurally elucidated. Many of them—e.g., vitamins and hormones—play an important qualitative role in Nature.

The quantitatively predominating and, therefore, technically most important substances occurring in Nature are high molecular. They are difficult to characterize, and therefore, up to the present time are far less known.. Examples are cellulose, starch, proteins, rubber, tannins, lignin, and the humic acids of soil.

Those high molecular compounds which are cleaved by acid or alkaline hydrolysis to recognizable products are better known than those which resist hydrolysis. Examples of the former class are cellulose, starch, and proteins, and of the latter class rubber, lignin, certain tannins, and humic acids. The hydrolyzable high molecular compounds are built up from small building stones—e.g., glucose or amino acids—and their nature has been completely elucidated. The building stones are linked together in a very regular manner to form the high molecular compounds.

Among the nonhydrolyzable high polymerides, rubber is best known. It is also built up very regularly from simple hydrocarbon (isoprene) units and its structure was established by cleavage with ozone.

It is very probable that lignin also possesses a similar architecture and that it is formed by linking relatively small units to each other in a more or less regular manner.

All high molecular compounds occurring in Nature appear to contain such periodically recurring building stones, although there may be some exceptions to this rule. This regularity obviously reflects the order which characterizes life.

If phenol is condensed with formaldehyde under ordinary laboratory conditions, the condensation takes place at random to yield three-dimensional giant molecules. It is impossible to attribute to these molecules any definite formulas. Because the components and their characteristic reactivities are known, it is possible to suggest a schematic representation of the general structural type, which is very probably correct. If the starting materials were not known, however, one would certainly hesitate to propose even a general scheme.

If the resol molecule just referred to is heated, it is transformed into a resit of quite different properties. Obviously, during the heating operation, giant molecules are linked to each other to form a supergiant molecule. The structure of that product is, of course, still less known and even more difficult to elucidate than the simple giant molecules.

The author is dwelling upon this point since, according to modern views, lignin is a naturally occurring phenolic plastic which, together with fibrous material (cellulose), forms wood.

In order not to complicate unduly the already complicated chemistry of lignin, it is very necessary not to treat lignin with reagents which are known to cause condensations. If lignin is handled in a careless manner, it condenses to form "supergiant lignin molecules," causing investigators still more trouble than the ordinary lignin itself. Since lignin lacks characteristic physical properties—e.g., melting point or solubility—these condensation reactions are often difficult to observe.

Is it possible to judge whether a lignin preparation is true original lignin or an artifact? The author thinks that it is. Lignin easily undergoes a very interesting and important reaction—the sulphonation reaction. It reacts with bisulphite cooking acid with the formation of lignosulphonic acids. Unchanged lignin forms water-soluble sulphonic acids rich in sulphur. Condensed lignins yield lignosulphonic acids of low sulphur content which may be more or less insoluble in water.

Lignin forms about 25 to 30% of sprucewood. It occurs in the cell walls together with cellulose and similar polysaccharides. The "middle lamella" between two adjacent cell walls contains more lignin than the inner part of the cell walls. The distribution of lignin in wood, therefore, is very uneven. This has been demonstrated by studying cell walls and middle lamellas manually separated by means of a micromanipulator. Still more useful is the physical method which is based upon measurement of the absorption of ultraviolet light in different parts of the cell wall (P. Lange).

Lignin, more or less unchanged, can be isolated in different ways:

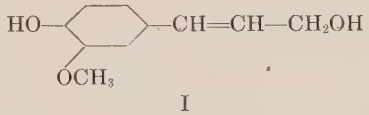
1. By removing the carbohydrate components of the wood—e.g., by means of acids.
2. By conversion of the lignin of the wood into soluble derivatives.
3. A small amount of ligninlike material can be extracted from wood by alcohols (Brauns' native lignin).

All these methods have their advantages and disadvantages. The first two yield a more or less changed lignin. The third gives only a small yield of a product which may be contaminated with other compounds closely resembling lignin—e.g., tannins. The main portion of the lignin (the protolignin) cannot be isolated in this way.

Holger Erdtman, Kungl. Tekniska Högskolan, Institutionen för Organisk Kemi, Stockholm, Sweden.

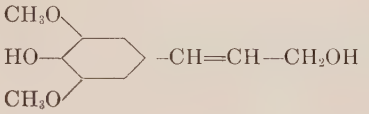
It has been suggested that wood does not contain lignin at all, but merely some peculiar carbohydrate which is transformed into so-called lignin when treated with acids or other reagents. The ultraviolet absorption studies, just referred to, however, were carried out with wood which had not been subjected to any chemical reactions and, therefore, disprove this view completely and definitely, and show that lignin is an aromatic compound containing one aromatic ring per unit of about ten carbon atoms. It has also been claimed recently that lignin has been prepared synthetically. This is completely wrong.

The grand old man of lignin chemistry, Peter Klason—a Swedish chemist—as early as 1896 held the view that spruce lignin is closely related to coniferyl alcohol (I), a ten-carbon atom compound of the constitution:

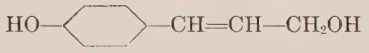


I

In addition to such units, hardwood lignin was supposed to contain other building stones related to syringenin (II). Hardwoods, therefore, contain more methoxyl than softwoods. According to more recent observations monocotyledons—e.g., rye straw, cornstalks, and many others—also appear to contain units lacking OCH_3 groups, the basic structure of which is III:



II

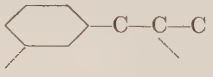


III

The ideas of Klason were substantiated by extensive studies by Karl Freudenberg in Germany, who studied the oxidative degradation of lignin, by Bror Holmberg in Sweden, who concentrated on analytical studies of different lignin derivatives, and by Harold Hibbert in Canada.

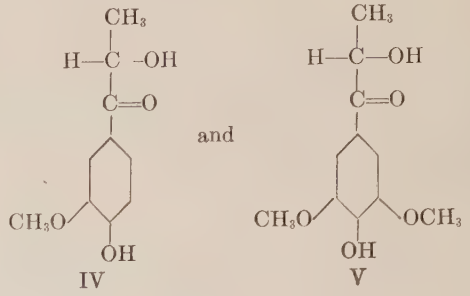
Analytical findings on various lignin preparations by different workers are in accordance with the view that conifer lignin contains a building stone having ten carbon atoms, one of which belongs to a methoxyl group. There are several other groups which must be postulated or which have been demonstrated analytically. They include hydroxyl groups and ether oxygen atoms. If hydrogen atoms are substituted by methoxyl, hydroxyl, and ether groups, there remains a fundamental structure of the approximate composition C_9H_{10}.

Many observations in lignin chemistry can be understood if this C_9H_{10} group is resolved into:



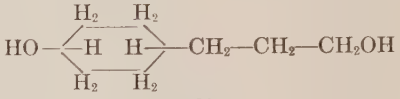
This unit is supposed to be repeatedly linked to similar units to form a chain of C_9H_{10} elements connected by C—C or C—O—C linkages.

The isolation of fission products from lignin containing an aromatic ring connected with a straight chain of three carbon atoms indicates that this idea is sound. By treating wood with alcoholic hydrogen chloride, Hibbert obtained the following substances (IV and V) in a small but not insignificant yield:



IV and V

They are closely related to coniferyl alcohol (I) and syringenin (II). Larger yields of C_6-C_3 compounds—phenylpropane derivatives—are obtained on hydrogenation of wood or different lignin preparations. An example is VI:

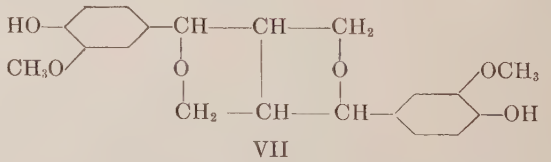


VI

Obviously, lignin is formed from progenitors occurring in the cambial sap and deposited in the walls of the cells formed in the cambial ring or around them in the form of the middle lamella.

Unfortunately, the chemistry and biochemistry of the cambium layer have been investigated only slightly. Such investigations are at present highly needed.

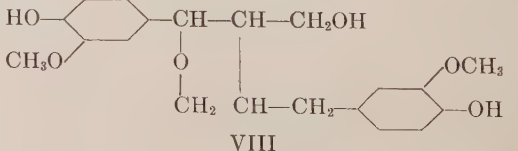
One chemical activity of this important part of the tree, which has a certain bearing on the problem of lignin formation, should be considered. If the cambium layer of spruce or pine is wounded, abnormal reactions take place, ultimately leading to the formation of a phenolic compound called pinoresinol. This is found in "gum resin," which occurs as solid, soft, or brittle lumps of resin covering small wounds or at least the periphery of large ones. From ancient times, it has been used in many countries as a sort of chewing gum. Pinoresinol (VII) has the following structure:



VII

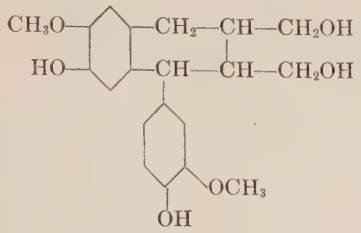
It is obviously formed from two C_6-C_3 units, perhaps identical with the hypothetical lignin progenitors, by means of a C—C linkage between the β-carbon atoms of the side chain.

A closely related compound, lariciresinol (VIII), occurs in the overflow resin of the larch (R. D. Haworth):



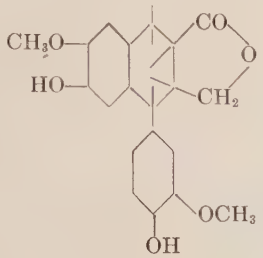
VIII

Treated with acids, lariciresinol is rearranged to isolariciresinol (IX):



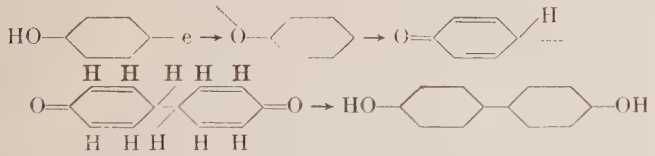
IX

This is oxidized to a monocarboxylic acid which forms a lactone known as "sulphite liquor lactone" or conidendrin (X):

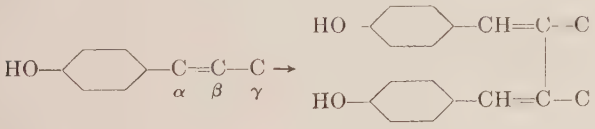


X

Conidendrin occurs in the heartwood of hemlocks and spruces. Its formation, undoubtedly, is the result of the normal activities of the cambium layer. Pinoresinol and lariciresinol appear to be pathological products. It is interesting to note that, in this group natural of compounds, the lignans, there is always a carbon-carbon link in the β-position connecting the C_6-C_3 units. Based on this observation, the author advanced a theory for the biosynthesis of such compounds and lignin. On dehydrogenation, phenols are often condensed to diphenols and this reaction was supposed by Goldschmidt and Pummerer to involve the intermediate formation of free radicals of oxygen:



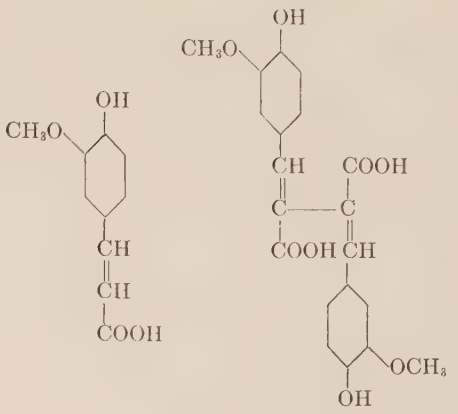
The coupling always takes place in the *o,p*-positions to the hydroxyl group. If however, a double bond was conjugated with the nucleus, the coupling could take place at the β-carbon atom of the side chain:



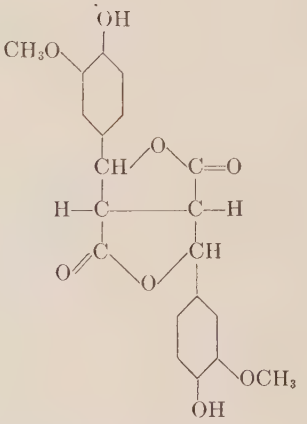
When ferulic acid (XI) was dehydrogenated, "dehydrodiferulic acid" was formed for which the author suggested the dilactone formula (XII). This was later proved to be true by R. D. Haworth.

The dehydrodiferulic acid (XII) obtained is closely related to pinoresinol (VII) and the other lignans.

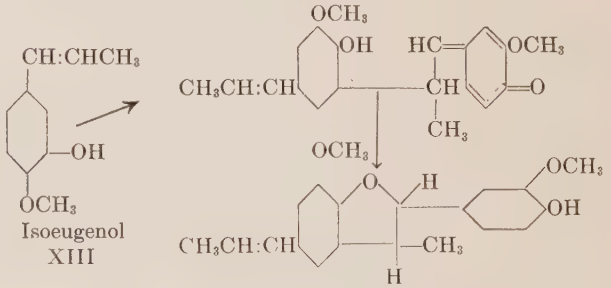
When isoeugenol (XIII) is dehydrogenated, a similar reaction takes place but, in this case, one β-carbon atom in the side chain is coupled with an ortho-carbon atom in the nucleus of a second isoeugenol molecule:



Ferulic Acid
XI



"Dehydrodiferulic Acid"
XII



Isoeugenol
XIII

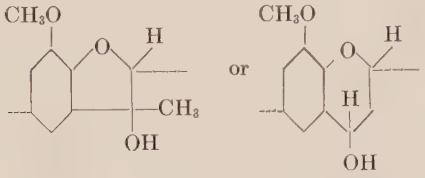
Dehydrodiisoeugenol
XIV

The resulting dehydrodiisoeugenol (XIV) has a structure which is very similar to those for lignin advanced by K. Freudenberg at that time. This caused the author to suggest that lignin might perhaps be formed in Nature by dehydrogenation of precursors of the coniferyl type. Further work along this line has been carried out by K. Freudenberg. It was also pointed out that simple dehydration of suitable lignin precursors would give rise to products capable of direct polymerization. An additional advantage of these views is that they explain why lignin is optically inactive.

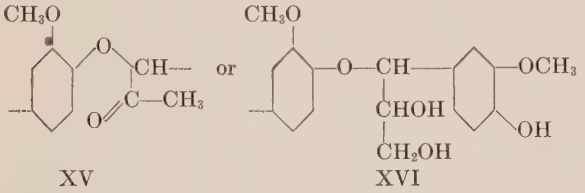
According to these ideas lignin is formed from simple progenitors, which are transformed enzymatically into reactive intermediates, which are then spontaneously polymerized. The latter process, so to speak, is not associated with "life." The order in the lignin molecules, therefore, is probably far less complete than in the cellulose molecules. The occurrence in lignin of

linkages between the β-carbon atoms, or the β-carbon atoms and the aromatic nucleus in the ortho-position to the hydroxyl group, appears to be especially probable.

As the result of his extensive and very successful researches on lignin, Freudenberg postulated structures for lignin containing elements of the types:

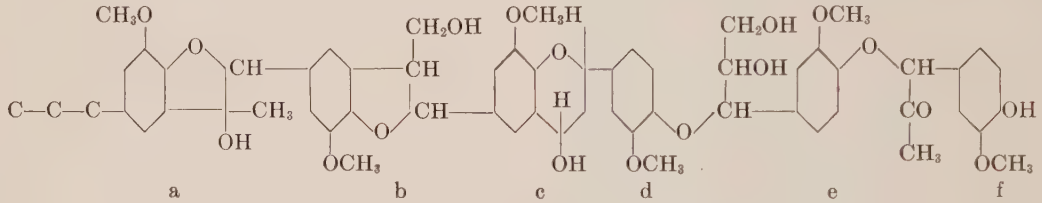


These or similar elements were supposed to be linked together by C—C linkages to form a chain. Here and there, linkages of other types (e.g., XV) must be postulated or even those with free phenolic groups (e.g., XVI):



XV XVI

A possible schematic formulation would be that shown in XVII:

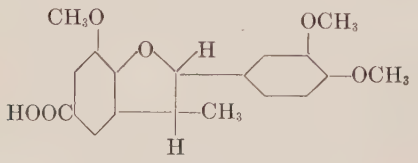


XVII

Such a formula would explain most of what is known about the properties of lignin. Strong alkali could break the ether linkages between d and e and e and f, as well as the oxygen rings of a, b, and c. Subsequent methylation and permanganate oxidation would give veratric acid from d, e, and f and isohemipinic acid from a, b, and c. These degradation products have been isolated from lignin in this way. Freudenberg's famous oxidative degradation of lignin and lignin derivatives to vanillin with nitrobenzene and alkali is readily explained. The yield is no less than about 25%. Elements d, e, and f would be anticipated to yield vanillin in this reaction.

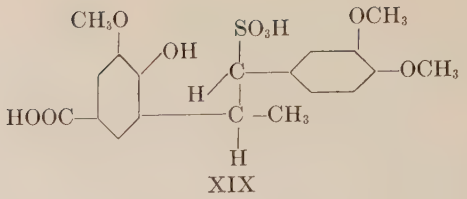
The question, however, arises: does this structure allow the ready sulphonation of lignin?

Freudenberg found that an acid derived from dehydrodiisoeugenol (XVIII):



XVIII

reacts with sulphite cooking acid to form a sulphonic acid (XIX):



XIX

which could be methylated and oxidized to isohemipinic acid and veratric acid. The sulphonation reaction, however, proceeds much less readily than with lignin. The same happens with a series of similar model substances for lignin. If this interpretation of the sulphonation reaction is true, then it must be concluded that each sulphonic acid group introduced would correspond to the formation of one new phenolic hydroxyl group.

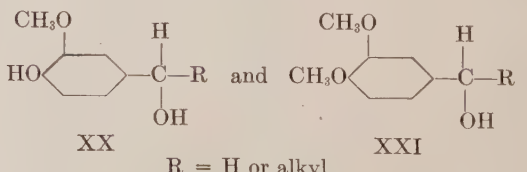
After having found that the number of phenolic hydroxyl groups is not increased upon sulphonation, Freudenberg recently suggested that the sulphonation also may involve the cleavage of ether linkages of the pinoresinol type. Pinoresinol, as well as its ethers have already been subjected to sulphite cooks. The results were negative.

If the sulphonation proceeds in this way, each sulphonic acid group introduced should correspond to the formation of a new alcoholic hydroxyl group.

Recent results in the author's laboratories however indicate that hydroxyl groups disappear when sulphonic acid groups are introduced. It cannot be denied, however, that the Freudenberg type of sulphonation may occur to a small extent.

Holmberg has performed some very important experiments. He subjected derivatives of benzyl alcohol ($C_6H_5CH_2OH$) to sulphite cooking. The hydroxyl group in this position possesses a remarkably great reactivity. Holmberg found that α-phenethyl alcohol [$C_6H_5CH(OH)CH_3$] was readily converted into a sulphonic acid of the formula $C_6H_5CH(SO_3H)CH_3$. The speed of reaction, however, was not sufficiently great to be comparable with that of lignin.

Therefore, B. Lindgren subjected benzyl alcohol derivatives of a more ligninlike constitution to sulphite cookings and found that compounds of the types XX and XXI react with sulphite as fast as lignin itself. Moreover, with these models, it was possible to imitate many other lignin reactions. At present, therefore, these substances are considered as being the best "lignin models" available:



XX and XXI

R = H or alkyl

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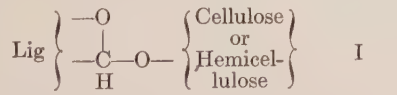
Nature of the Sulphite Pulping Reaction

HOLGER ERDTMAN

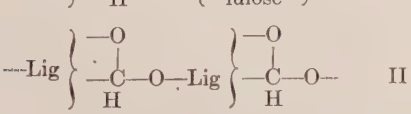
The chemistry of the sulphite pulping process is discussed in its relation to the sulphonation of lignin. Sulphonation of wood under acid conditions causes a cleavage of the acetal linkages connecting the lignin molecules with the substitution of hydroxyl groups that results in soluble groups. The constitution of lignin and its reactions are presented.

THE sulphonation and delignification of wood under the conditions of the normal sulphite process is a very complex series of reactions. The elucidation of the chemistry of this technically important process is mainly due to E. Hägglund of the Swedish Wood Research Institute, Stockholm. In stating this, of course, the author does not overlook that there have been very important contributions from others.

The sulphite pulping process proceeds in two different stages. During the first stage, when the acidity of the cooking liquor is still rather low, the lignin of the wood reacts with sulphurous acid to form a solid insoluble sulphonic acid ("sulphonated wood"). This very strong acid withdraws calcium ions from the cooking acid just as an ordinary cation exchanger (such as Amberlite) does. This withdrawal of calcium ions from the cooking acid, of course, makes it increasingly acid and the next stage of the pulping process starts. This is supposed to be, essentially, a hydrolysis of acetal linkages in the solid acid, followed by further introduction of new sulphonic acid groups. The result is the formation of a soluble lignosulphonic acid which remains in the waste liquor. This hydrolysis is a most important feature of the pulping process. If the solid lignosulphonic acid is hydrolyzed in alcohol, ethoxyl groups are introduced into the lignin component, forming an ethoxylated, soluble lignosulphonic acid. Hence, the solution of the lignosulphonic acids in the later phase of the sulphite cook is not merely the result of the new sulphonic acid groups introduced which cause an increased hydrophilic nature of the lignin. The alcoholytic introduction of ethoxyl into the lignin molecule shows that hydroxyl groups in the lignin are not combined with "carbonyl" groups of the cellulose (or hemicellulose) component of wood. On the contrary, the "carbonyl" groups must be sought in the lignin molecule itself. I is one possible type of



I



II

combination, and II is another. In the first case, lignin provides the carbonyl group and carbohydrates, the hydroxyl group. In the second case, lignin molecules provide both groups. Both types are acetals, being lignin-carbohydrate complexes or lignin-lignin complexes. The first case may be realized with lignin deposited in the cell wall which is poor in lignin. The second, perhaps, is represented by the lignin of the lignin-rich middle lamella where, from spatial considerations, lignin-carbohydrate complexes may be less probable.

In 1934 Kullgren performed the following important experiments. Raw sulphite pulp was washed with dilute hydrochloric acid, with the result that all calcium ions were removed and exchanged for hydrogen ions. If this material—which now contains the free, solid, insoluble lignosulphonic acid—is heated with water to a moderate temperature, the acetal-like combinations of the insoluble, solid lignosulphonic acid are cleaved because of the acidity of the lignosulphonic acid itself. The product is a soluble lignosulphonic acid.

Hägglund and his co-workers sulphonated sprucewood employing a concentrated solution of sodium bisulphite (15%) or a mixture of sodium sulphite and sodium bisulphite. They obtained a sulphonated wood in which most of the original lignin remained undissolved. This is obviously caused by the low acidity and the great buffer capacity of the cooking liquor which inhibits the later phase of the sulphite cook—that involving the hydrolytic dissolution of soluble lignosulphonic acids.

A small portion of the lignin, however, is always lost; this quantity increased with increasing acidity of the cooking acid.

These lignosulphonic acids appear to have rather low molecular weights because they are only partly precipitated by organic bases. The conclusion that they have low molecular weights is supported also by the fact that they pass only partially through a column of an anion exchanger. High molecular cations pass through anion exchangers without being retained. This phenomenon is generally supposed to be caused by the porous nature of the anion exchanger. Large cations cannot penetrate finely porous anion exchangers. Freudenberg has carried out extensive studies in this field in order to find anion exchangers which would bind also the high molecular lignosulphonic acids and Samuelson, as well as we, has long used this method to separate lignosulphonic acids from sulphite waste liquors into high molecular and low molecular lignosulphonic acid fractions.

It is very difficult to say whether these low molecular lignosulphonic acids are formed from low molecular lignin fractions in the wood or if they are formed by a fission of high molecular lignin. It is a general rule that, when lignin is converted into derivatives (e.g., by alcoholysis or phenolation), fractions are obtained of

HOLGER ERDTMAN, Kungl. Tekniska Högskolan, Institutionen för Organisk Kemi, Stockholm, Sweden.

very different molecular weight. Therefore, it appears probable that the genuine lignin in the wood occurs partly in a rather low molecular or easily hydrolyzable form, and partly in a high molecular form. It cannot be denied, however, that wood may contain lignin of a rather definite molecular magnitude and that it undergoes a simultaneous polymerization and depolymerization when subjected to the action of acids. However, it appears to be certain that, once a high molecular lignin preparation—e.g., a lignosulphonic acid—has been formed, it is usually difficult to depolymerize it by further sulphonation.

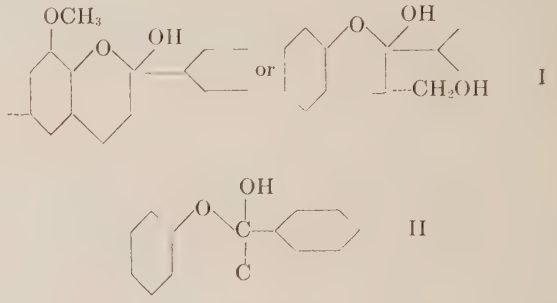
The lignin which is not lost when wood is heated with strong sulphite or bisulphite solutions is also sulphonated to some degree. The higher the acidity and the longer the duration of the heating, the more highly sulphonated it is. When the free acids are heated with water according to the Kullgren process, lignosulphonic acids are liberated in large quantities. These have been subjected to extensive studies at Stockholm. The result is that these "Kullgren lignosulphonic acids" are considered as being the best materials available for studies of the structure of lignin.

Since they are obtained from Hägglund's sulphonated wood—or rather from the solid, insoluble lignosulphonic acids which it contains—these lignosulphonic acids contain an abnormally low percentage of sulphur. Since they are prepared from an insoluble starting material simply by treatment with water, they are obtained directly in a very pure form or are very easily purified. When heated with bisulphite cooking acid, they are easily sulphonated. Generally, the lignosulphonic acids obtained from sulphonated wood contain one sulphonic acid group per three or four lignin building stones (three or four methoxyl groups). On sulphonation, one easily reaches a stage where almost all lignin building stones are sulphonated (one sulphonic acid group per methoxyl group). The ordinary technical lignosulphonic acids from waste liquor contain one sulphonic acid group per two methoxyl groups (two lignin building stones). Some of the lignosulphonic acids from the manufacture of strong sulphite pulp can be further sulphonated to about one sulphonic acid group per 1.5 lignin building stones. Those isolated from rayon pulp waste liquors are less easily sulphonated. When the sulphur-poor lignosulphonic acids are further sulphonated, *the hydroxyl content decreases as the sulphur content increases,* thus indicating that the sulphonation process is essentially a substitution of hydroxyl groups by sulphonic acid groups. The ultraviolet absorption curves of the sulphur-poor lignosulphonic acids show that they are more similar to homogeneous, pure substances than other lignosulphonic acids or lignin derivatives. The general type of the absorption curves shows, with a high degree of probability, that lignin has a constitution very similar to that proposed by Freudenberg. When the low sulphonated lignosulphonic acids are sulphonated further, the absorption does not change.

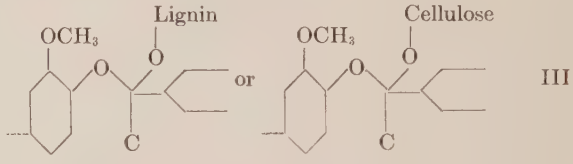
These results show that a "soluble lignin" containing still less sulphur—and finally no sulphur at all, if such were obtainable—would possess an ultraviolet absorption similar to that of sulphur-poor lignosulphonic acids or their sulphonation products. As a matter of fact, Brauns' alcohol-soluble "native lignin" has an ultraviolet absorption very similar to that of the sulphonic acids obtained from this lignin.

In the Freudenberg structure for lignin, there are hydroxyl groups of the benzyl alcohol type which could provide a point of attack for the cooking acid and permit the formation of stable sulphonic acids. On the whole, however, it is difficult to understand the formation of the solid lignosulphonic acids and their hydrolysis solely on the basis of Freudenberg's schemes.

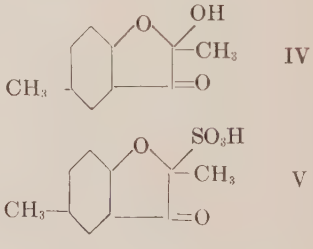
Therefore, the author suggested that lignin may contain structures of the types I, or, simplified, II.



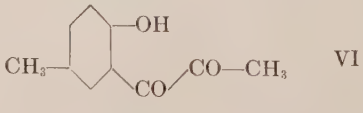
These components are hemiacetals and the hydroxyl group is supposed to connect lignin molecules in the wood with formation of large acetal complexes or with carbohydrates—e.g., as in III.



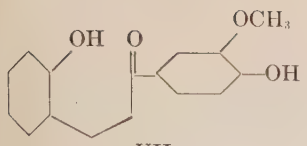
As acetals, these complexes should be easily hydrolyzed with dilute aqueous acids or alcoholyzed by alcoholic acids. Unfortunately, suitable model substances are difficult to make. The best model found up to the present time is IV. It is easily sulphonated with loss of hydroxyl groups to form V.



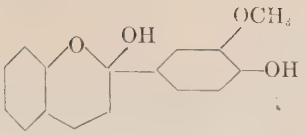
The ultraviolet absorption curve shows no change when the hydroxyl group is substituted by the sulphonic acid group. The former substance is a cyclic hemiacetal of the diketone, VI.



VI must have an ultraviolet absorption entirely different from that of IV. The substance VII similarly could exist in the *cyclo*-acetal form VIII:

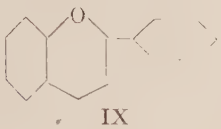


VII



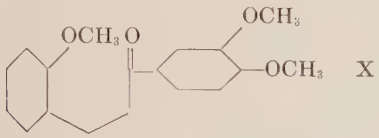
VIII

The ultraviolet absorption of VIII would be anticipated to be similar to that of IX.



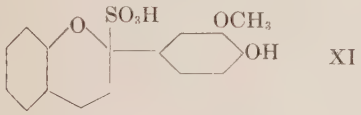
IX

This is not the case, however. On the contrary, the ultraviolet absorption is very similar to X.



X

Hence, VII and not VIII must be the true structure of the compound. In accordance with this finding, VII is not converted into a sulphonic acid of formula XI by sulphite cooking acid but is recovered unchanged.



XI

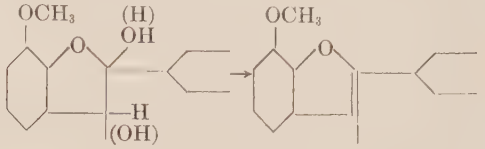
The studies of similar model substances are now in progress and will be of interest in connection with the question of whether lignin contains five-membered or six-membered heterocyclic rings.

It may perhaps be ventured that softwood lignin is formed in the cambium layer from precursors related to coniferyl alcohol. In hardwood lignin, elements related to syringenin are also incorporated. Lignin formation is probably an enzymatic reaction involving a dehydrogenation or dehydration of one or a few simple phenolic precursors. The polymerization then follows spontaneously, yielding optically inactive polymers.

In wood these polymers are probably linked to other similar polymer molecules or to carbohydrates by linkages which can be cleaved easily by acids. They are presumably acetal linkages.

Sulphonation of wood is supposed to involve substitution of hydroxyl groups. In the first stage, a solid lignosulphonic acid of very large molecular weight is formed. Further sulphonation under more acid conditions causes cleavage of acetal linkages connecting lignin molecules or lignin and carbohydrate molecules with simultaneous substitution of those hydroxyl groups which are hereby liberated. The result is soluble, relatively low molecular lignosulphonic acids. On the basis of the assumption of lignocarbohydrate complexes, this may be summarized as shown in Fig. 1.

In technical pulping, especially, the sulphonation taking place in the later stages of the process undoubtedly competes with another reaction, involving the inactivation of hydroxyl groups. Probably water is split off with the formation of double bonds or condensation with other lignin molecules.



Therefore, it is impossible to isolate lignosulphonic acids containing one sulphonic acid group per lignin building stone from technical waste liquors or to sulphonate lignosulphonic acids obtained from technical waste liquors to products of such a high content of sulphonic acid groups.

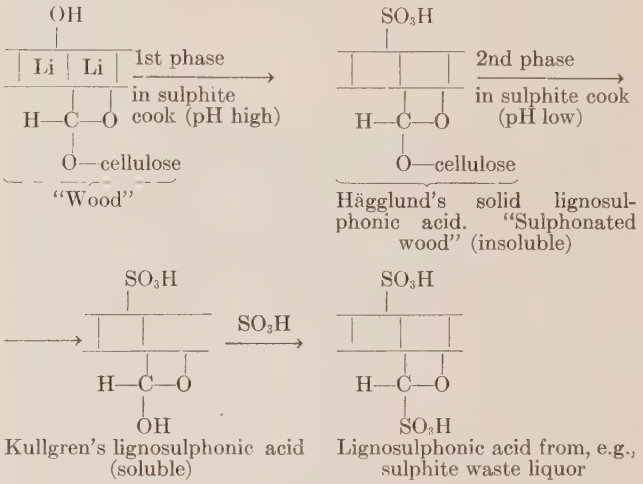

1st phase
in sulphite cook (pH high)
"Wood"
2nd phase
in sulphite cook (pH low)
Hägglund's solid lignosulphonic acid. "Sulphonated wood" (insoluble)
Kullgren's lignosulphonic acid (soluble)
Lignosulphonic acid from, e.g., sulphite waste liquor

Fig. 1

The removal of water molecules from the lignin is believed to take place in such a way that double bonds conjugated with the aromatic nuclei are formed, because that would explain why lignosulphonic acids isolated by the Kullgren method and those from waste liquors from strong sulphite pulp and rayon pulp cooks show a successively increased ultraviolet absorption in the region of about 300 to 330 mmu.

Low sulphonated lignosulphonic acids, which of course still contain reactive groups, easily undergo condensations when treated with acids. The products are insoluble. This has considerable interest in connection with the so-called burnt cooks. Obviously these are caused by the condensation of low sulphonated lignosulphonic acids or the solid, insoluble lignosulphonic acids. The condensation products must have a very high molecular weight and, since the condensation involves groups which, in normal cooks, would have been sulphonated, they are low sulphonated and cannot be sulphonated further to products of sufficiently hydrophilic nature to permit dissolution.

It has been found by H. W. Giertz that such condensation products are difficult to remove from pulp by the ordinary bleaching processes, a fact of great technical importance.

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Determination of Bacterial Degradation of Woolen Fibers

B. F. SHEMA and J. W. APPLING

MANY of the more more common microorganisms have the ability to cause severe damage to papermakers' felts. These microorganisms are proteolytic in nature and, consequently, the individual fibers, when attacked, are either ruptured or considerably weakened. Oftentimes, it is highly desirable to determine whether or not a particular felt is being attacked while still in service, and also whether or not unexpected short felt life is due to these microorganisms.

It is hoped that the following method will be useful to the industry in determining the extent of bacterial degradation of woolen fibers. This method has been used successfully at The Institute of Paper Chemistry for the past several years. It is simple and requires only a minimum amount of equipment. Although it is common knowledge that many vegetable fibers can be stained to show microbiological attack, the writers are unaware of the use of such a method to show microbiological attack on the woolen fibers of papermakers' felts.

Select and cut several representative samples (approximately 2 inches square) from the damaged felt and unravel several threads from each square in both the woof and warp directions. Adequate care should be taken throughout the procedure to prevent mixing of sample fibers. Wash the threads in tap water, place them in a Petri plate or shallow dish, and separate into the individual fibers. Wash these fibers in several changes of distilled water. The washing should be sufficient to remove all extraneous matter. After being thoroughly cleaned, the fibers should be dried between bibulous paper.

After the fibers are dry, immerse them in a 1% aqueous solution of safranin and, after 1 minute, remove from the stain and wash in distilled water. The fibers should be washed by dipping in water until the wash water does not appreciably change color. Again dry the fibers between bibulous paper. Care should be taken that the dishes are thoroughly cleaned after each experiment and that fresh stain is used for each sample. After the fibers are dried, mount them in glycerin or clear mineral oil on a clean slide, cover with a cover slip, and examine under a microscope.

The degree of bacterial degradation is determined by the extent to which the fibers absorb the stain. As shown in Fig. 1, the normal fiber is not stained. Figures 2 to 4 show fibers attacked by bacteria. The extent of the degradation is shown by the darkened (stained) areas. Figure 2 shows only slight bacterial degradation. Figure 3 shows a degraded fiber (one which is almost completely stained); this fiber is so degraded that it would have very little tensile strength. Figure 4 shows a completely degraded fiber whose strength would be almost nil.

Fig. 1. Normal fiber. Note the absence of stained areas and the presence of scales

Fig. 2. Slight bacterial decomposition. Note stained areas along the fiber; few of the scales have disappeared

Fig. 3. Severely damaged wool fiber. The fibers are almost completely stained; note the absence of scales

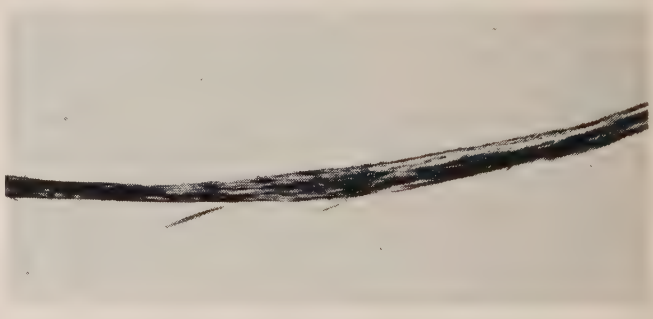

Fig. 4. Completely degraded wool fiber. The scales are entirely removed and the fiber is disrupted. Note the presence of fibrils

B. F. SHEMA, Member TAPPI; Research Assistant, The Institute of Paper Chemistry, Appleton, Wis.
J. W. APPLING, Member TAPPI; Director of Microbiological Research, Buckman Laboratories, Memphis, Tenn.; formerly Research Associate, The Institute of Paper Chemistry, Appleton, Wis.

RECEIVED Oct. 27, 1948.

The Grinding of Hardwoods

Experiments on Eastern Cottonwood, Yellow Poplar, Sugar Maple, Black Tupelo, White Ash, Paper Birch, and Sweetgum

AXEL HYTTINEN and E. R. SCHAFER

Groundwood pulping experiments were made at the Forest Products Laboratory on seven untreated and two pretreated hardwoods at various pressures and stone surface conditions ranging from sharp to dull. Paper suitable as a base for coated groundwood book grades was made with six of the untreated hardwood groundwoods and toweling paper was made containing the untreated and pretreated groundwoods prepared from one of the species.

The grinding characteristics of cottonwood and yellow poplar were similar and pulps were produced, which although they were short-fibered, and required considerable energy, were comparable in strength with commercial newsprint groundwood pulp. Black tupelo and sugar maple yielded pulps were of fair strength but those from sweetgum, white ash, and paper birch were low in strength. The color of the black tupelo, yellow poplar, and white ash pulps was good, and that of cottonwood and paper birch was fair. Pulps made from sweetgum and sugar maple were dark and, unbleached, would be limited in their use.

Pretreatment of paper birch wood with neutral sodium sulphite increased the strength, freeness, and fiber length of the pulp, and decreased energy consumption without affecting the color. Similar pretreatment of sweetgum caused the production of pulp with high freeness and greater fiber length at lower energy consumption than from the untreated wood but did not improve its low strength.

The groundwood pulps were mixed with bleached sulphate pulp and made into coating stock for book paper. Toweling paper was made from mixtures of the pretreated and untreated paper birch groundwoods with spruce groundwood and sulphite pulps. The tests indicate that, though the hardwood groundwood pulps are lower in strength than softwood groundwood pulps prepared under comparable conditions, they can be blended with stronger pulps and made into acceptable papers. Without bleaching some of them would have limited use in the whiter papers.

THE utilization of little-used species for pulping has received considerable attention with the decrease in availability of the preferred species and also with the realization that the harvesting of hardwoods along with the softwoods results in better forest stands. In order to encourage and permit greater utilization of hardwoods for groundwood pulping, it is necessary that more information be obtained on their grinding characteristics and the properties of pulps produced from the various hardwood species.

This report presents the results of groundwood pulping and papermaking experiments made at the Forest Products Laboratory on seasoned Eastern cottonwood (*Populus deltoides* Bartr.), yellow poplar (*Liriodendron tulipfera* L.), a hard maple (probably sugar maple, *Acer saccharaphorum* K. Koch), black tupelo (*Nyssa sylvatica* Marsh), paper birch (*Betula papyrifera* Marsh), sweetgum (*Liquidambar styraciflua* L.), white ash (*Fraxinus americana* L.), and also on pretreated paper birch and sweetgum.

AXEL HYTTINEN, Chemical Engineer, and E. R. SCHAFER, Chemical Engineer, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture. Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

PREVIOUS WORK

The amount of published information on the grinding of hardwoods is small compared to that on coniferous woods. Studies made previously at the Forest Products Laboratory on swamp tupelo, paper birch, green ash, sugarberry, Eastern cottonwood, black willow, and American elm showed that satisfactory pulps can be made from most of these species for use in certain groundwood furnishes (*1*). This work as well as that of a number of others on groundwood pulping of hardwoods and pretreated wood has been briefly reviewed (*2*). Experiments made at the Forest Products Laboratory on the grinding of quaking aspen indicated that a dull stone surface was preferable for producing a pulp of a given strength in the freeness range usually used for book paper although certain of the pulps prepared on the sharper stone surfaces also appeared to be satisfactory in the experimental paper machine runs on book paper (*3*). More recently at the Forest Products Laboratory (*4*) it was experimentally shown that the sheet properties of a commercial base stock for coated paper consisting of 50% aspen groundwood of low freeness and 50% of softwood sulphite could virtually be duplicated by using an aspen groundwood of higher freeness and substituting aspen semichemical pulp for 60% of the sulphite. This substitution raised the aspen content of the paper from 50 to 80%.

DESCRIPTION AND PREPARATION OF THE WOOD

The wood used in these experiments was received at the Forest Products Laboratory from Canton, North Carolina, except for the black tupelo which came from Houston, Texas, and the paper birch which came from Rhinelander, Wisconsin. Table I presents data on diameter, age, rate of growth, and density of the various samples.

The wood, when received, was peeled and contained 20 to 30% moisture except the black tupelo which was somewhat higher in moisture content. The cottonwood, yellow poplar, and sugar maple consisted of split and whole logs. The other species were whole logs. The pulps used for the paper machine runs

were prepared shortly after the wood was received. Most of the other pulping experiments, however, were made about a year later. The wood had been stored out of doors and was therefore fairly well seasoned when used. The logs were cut into blocks 6 inches in length and assorted into comparable batches of 70 to 100 pounds each. The samples thus prepared were stored unprotected out of doors, being used (one batch to an experiment) as needed, through the winter and following summer. The experiments were by this time about half completed. To retard deterioration, the remaining blocks were stored in a room at 40°F. and used as needed until the experiments were completed.

Table I. Physical Characteristics of the Wood

Species	*Average diameter, inches*	*Average years*	*Average rate of growth, rings per inch*	*Density (oven-dry weight and green volume), pounds per cubic foot*
Yellow poplar	8.9	22	5.1	24.9
Eastern cottonwood	...	...	5.3	23.5
Sugar maple	7.3	53	14.5	31.5
Black tupelo	11.1	106	19.0	31.2
White ash	7.8	97	25.0	34.0
Paper birch	6.0	24	8.0	30.0
Sweetgum	6.0	38	12.6	29.6

For experiments added to the original plan, it was necessary to prepare additional batches of cottonwood, maple, and paper birch for use with the dull stone surface condition (recorded in series D of the tables). For pretreatment, the sweetgum and paper birch logs were cut into 25-inch lengths which, after being treated, were each cut into four pieces without trimming the original ends.

GRINDER EQUIPMENT AND OPERATION

The Forest Products Laboratory experimental grinder and the method of operation used in these experiments were essentially as has been described previously (*3*). Briefly, the grinder has three pockets 16 inches wide and takes blocks of wood cut 6 inches long with the grain. A 54-inch diameter by 8-inch wide Norton 3760/5N7 pulpstone dressed with a 10-cut, 1 1/2-inch lead, spiral burr and a 14-point diamond burr was used for runs 480 through 493, the pulps which were used for the paper machine runs on book coating stock. For the remaining runs a Norton 38A90-L10VP pulpstone with the same burr pattern was used.

The groundwood pulps were screened through flat plate screens having slots 0.008-inch wide and dewatered on a wet machine when the pulp was to be used for papermaking experiments or on a suction filter when only a test sample was taken.

Pulp test sheets of about 115-pound-basis-weight (25 × 40—500) were made and tested by TAPPI Standard Methods. The screen analyses were made with an Appleton selective screen.

PRETREATMENT OF WOOD

Sweetgum and paper birch, examples of southern and northern high-density hardwoods, respectively, were subjected to a vacuum-pressure treatment in a solution consisting of about 80 grams per liter of sodium sulphite and 20 grams per liter of sodium bicarbonate. Table II presents data on the treatments.

For grinder runs 529 and 530, made on the sharp surface in series A, the two species were treated together in a vertical digester of about 10 cubic feet capacity. A four-cycle treatment was used consisting of (1) a 1/2-hour vacuum stage with the wood immersed in the treating solution, (2) heating the solution to 250°F. with both direct and indirect steam followed by direct steam on top of the liquid to increase the pressure to 140 p.s.i. and to maintain it for 1/2 hour, (3) relieving of pressure and applying vacuum for 1/2 hour, and (4) applying heat and pressure to 250°F. and 140 p.s.i., respectively, for 1/2 hour. The pressure was then relieved, the liquor drained, and the wood discharged and ground within 2 hours.

The wood for grinder runs in series C and D was pretreated in a horizontal cylinder 6 feet long by 2 feet in diameter. Because of the limited capacity of this cylinder and the greater quantity of wood to be treated than for runs in series A, the two species were treated separately. The treatment for both species consisted of two stages: (1) a 1-hour vacuum stage during which the treating solution was drawn in and (2) a 1-hour pressure stage with the temperature at about 250°F. and pressure of 150 p.s.i. obtained by compressed air on top of the liquid. The pressure was then released and the liquor drained.

The temperature inside of the treating cylinder was measured by means of a thermocouple placed inside the door. Observations in other experiments made subsequently with this cylinder, however, indicated the temperature to vary from 10 to 20°F. from one part of the cylinder to another. Since there was no forced liquor circulation, it is conceivable that this temperature difference might be due to stratification. A certain amount of variation could, therefore, be expected between one treatment and another because differences in charging the wood probably would affect natural liquor circulation.

The wood for the runs 612–617, inclusive, on the medium-dull surface, series C, was discharged from the cylinder and ground immediately, whereas the wood for runs 666–671, inclusive, on the dull surface, series D, was allowed to remain in the cylinder overnight (about 15 hours) after draining the liquor and before grinding. Due to the slow cooling a greater degree of softening of the wood might have occurred in the

Table II. Pretreatment of Wood for Grinding

Species	*Dryness of wood, %*		*Liquor analysis, g. per liter*				*Groundwood pulping experiments*	
	Before treating	*After treating*	*Before treating* Na_2SO_3	*Before treating* $NaHCO_3$	*After treating* Na_2SO_3	*After treating* $NaHCO_3$	*Grinder run Nos.*	*Stone surface condition*
Paper birch	68.3	52.2					529	A
Sweetgum	78.8	52.7	83.0	19.2	48.0*	6.7*	530	A
Paper birch	80.7	44.5	83.3	20.8	80.5	20.4	612, 613, 614	C
Sweetgum	79.0	48.9	77.8	18.9	75.4	17.8	615, 616, 617	C
Paper birch	83.0	48.6	75.8	19.8	69.4	16.2	666, 667, 668	D
Sweetgum	86.0	47.7	77.8	18.4	76.2	17.4	669, 670, 671	D

* Low value probably due to dilution since direct steam was used in this treatment.

latter case, which may partly account for the freer pulp produced in this series than in Series C.

GRINDING AND PAPERMAKING EXPERIMENTS

Grinder runs 480 through 493 were first made on cottonwood, yellow poplar, black tupelo, sugar maple, sweetgum, white ash, and, for comparison, on southern yellow pine to produce pulps of about 100 ml. Canadian Standard freeness for papermaking experiments on book coating stock. Later a more comprehensive study on the grinding of the above species, except the southern pine but including paper birch and also pretreated paper birch and sweetgum, was made. The grinding experiments were made on each species at four different stone surface conditions varying from sharp to dull. The stone surfaces were about the same as those used in a concurrent study on aspen in which the surfaces were arbitrarily selected on the basis of the freeness of aspen pulp produced at 15 pounds pressure of wood on stone and a pit temperature of 165°F. The stone surface was dulled by grinding miscellaneous wood and by use in other work until trial runs on aspen at the above conditions produced pulps of about 200, 120, 90, and 60 ml. freeness (Canadian Standard). These stone surfaces are referred to, in this study, as sharp (series A), medium-sharp (series B), medium-dull (series C), and dull (series D), respectively. The time of service on the pulpstone prior to the start of the experiments in each series was about 30, 77, 247, and 372 hours, respectively.

Grinder runs were made on all species at a pressure of 15 p.s.i. of wood on stone at each of the four stone surface conditions. In addition, runs were made on all species at 20 and 25 pounds pressure on the medium-dull and dull surfaces. On some species, runs were made on the dull surface at 35 pounds pressure. The pretreated sweetgum and paper birch were ground at the same conditions as the untreated wood except that no runs were made on the medium-sharp stone surface. Tables III, IV, and V present the data on grinding characteristics and pulp properties.

Experimental paper machine runs were made to produce groundwood book coating stock paper. The furnishes of these runs consisted of 40% of commercial bleached pine sulphate and 60% of one of the groundwood pulps. Paper machine runs of toweling paper were also made in which pretreated or untreated paper birch groundwood pulps were substituted in part or entirely for the spruce groundwood. Each of the four different fibrous furnishes were run (a) without wet-strengthening resin and (b) with 2%

Table VI. Properties of Groundwood Book Coating Paper Containing Hardwood Groundwood Pulps

Machine run No.	Groundwood used[1] Grinder run No.	Species	Freeness of stock at head box (Schopper-Riegler), ml.	Weight, lb.	Thickness, mils	Paper properties: Bursting strength (25 × 40—500), pt. per lb. per ream	Tearing strength (25 × 40—500), g. per lb. per ream	Tensile strength p.s.i.	Tensile strength lb. per in. width	Double folds No.	Density, cc.	Gloss, %	Porosity, sec.	Brightness, %	Opacity, %
2735	487	Black tupelo	340	56.6	4.3	0.26	0.98	2536	10.9	8	0.73	37	40	68.0	96
2741	480	Sugar maple	340	52.7	4.0	0.25	1.03	2370	10.5	10	0.73	34	27	48.4	99
2744	486	Sweetgum	450	52.2	4.0	0.17	0.93	1655	7.6	6	0.72	34	16	49.4	98
2749	488	White ash	360	53.6	4.3	0.26	0.76	2609	12.0	5	0.69	34	36	59.8	96
2751	482	Eastern cottonwood	430	55.6	4.5	0.28	1.04	2820	12.7	7	0.68	38	48	49.7	99
2753	489	Yellow poplar	460	53.4	4.4	0.27	0.74	2445	12.0	3	0.67	34	64	0.9	96
	For comparison														
2736	485[2]	Southern pine	290	53.1	4.0	0.29	0.92	3005	12.0	25	0.73	38	104	61.0	94
2601	[3]	Spruce and aspen	350	39.8	3.2	0.26	0.52	1955	..	..	0.69	34	89	61.5	95

[1] The furnishes consisted of 60% of the groundwood indicated and, unless otherwise noted, 40% of southern pine bleached sulphate pulp, based on total weight of moisture-free fiber.
[2] Pulp from grinder run 485 was low in freeness and had good strength.
[3] The furnish was 60% commercial book grade groundwood and 40% commercial bleached sulphite. The groundwood was low in freeness and had good strength.

Table VII. Properties of Creped Toweling Paper Containing Paper Birch Groundwood Pulp

Machine run No.	Condition	Weight per ream,[1] lb.	Thickness,[2] mils	Wet tensile strength[3] lb. per in. width	Wet tensile strength[3] p.s.i.	Dry tensile strength lb. per in. width	Dry tensile strength p.s.i.	Water absorption, sec.	Stretch, %	Bursting strength, pt. per lb. per ream[1]	Tearing strength, g. per lb. per ream[1]	Porosity, sec.	Brightness, %	Density, cc.
	A. Reference Standards—50% spruce groundwood pulp (P2304)[4]													
2918	Nonwet-strengthened	39.2	10.9	0.23	21	3.21	295	8	7.3	0.20	1.03	0.2	51	0.20
2919	Wet-strengthened[5]	37.1	9.3	0.59	64	2.66	286	71	7.8	0.22	0.94	0.5	54	0.22
	B. 50% Untreated paper birch groundwood pulp (grinder run 608)[4]													
2920	Nonwet-strengthened	37.5	9.5	0.18	19	2.31	243	20	6.6	0.21	0.66	0.7	55	0.22
2921	Wet-strengthened[5]	35.1	8.8	0.48	55	2.31	262	32	6.6	0.23	0.73	0.5	53	0.22
	C. 25% Untreated paper birch groundwood (grinder run 608) and 25% spruce groundwood (P2304)[4]													
2924	Nonwet-strengthened	36.7	8.7	0.20	23	1.95	224	11	5.7	0.19	0.56	0.3	54	0.23
2925	Wet-strengthened[5]	36.8	9.5	0.59	62	2.60	274	74	7.0	0.20	0.70	0.4	54	0.21
	D. 25% Each of pretreated paper birch groundwood pulps (grinder runs 613 and 614)[4]													
2922	Nonwet-strengthened	37.0	9.9	0.21	21	2.91	294	9	6.7	0.20	0.74	0.3	55	0.21
2923	Wet-strengthened[5]	39.4	10.3	0.58	56	2.61	254	42	4.0	0.16	0.69	0.3	53	0.21

[1] Ream size, 25 × 40—500.
[2] Thickness measured on creped sheet.
[3] Ultimate tensile strength determined on a 1-inch width strip. No weight on tester. The immersion period was 60 seconds for the nonwet-strengthened papers and 90 seconds for the wet-strengthened papers.
[4] The papers also contained 50% spruce unbleached Mitscherlich sulphite pulp (P2433).
[5] Wet-strengthened with 2% melamine resin added at the beater.

Table III. The Groundwood Pulping of Eastern Cottonwood and Yellow Poplar

Stone surface condition[1]	Grinder run No.	Wood dryness, %	Grinding data: Pressure of wood on stone,[3] p.s.i.	Grinding data: Shower-water temperature,[4] °F.	Grinding data: Consistency, %	Grinding data: Stone service time,[5] hr.	Grinding data: Grinding rate per 24 hours[6] (moisture-free wood), tons	Grinding data: Power input,[6] hp.	Grinding data: Energy consumed per ton (moisture-free wood), hp.-days	Properties of pulp suspension: Freeness: Schopper-Riegler, ml.	Freeness: Canadian Standard, ml.	Screen analysis: Retained between: Retained on 24-mesh, %	24- and 42-mesh, %	42- and 80-mesh, %	80- and 150-mesh, %	Passing 150-mesh, %	Fiber-length index	Properties of pulp test sheets[2]: Bursting strength (25 × 40 —500), pt. per lb. per ream	Tearing strength (25 × 40 —500), g. per lb. per ream	Tensile strength lb. per in. width, p.s.i.	Density, g. per cc.	Brightness, %
Eastern cottonwood																						
[7]	482	67.9	23	...	3.5	[7]	0.65	57	87	382	100	1.0	7.8	21.3	19.0	50.9	0.082	0.18	0.50	995	..	0.39	49.8
A	525	74.8	15	115	3.6	30	0.70	36	51	345	82	1.1	5.2	5.7	24.4	63.6	0.070	0.09	0.41	650	10.4	0.38	53.6
B	554	77.8	15	95	3.1	77	0.45	41	90	260	60	0.7	4.5	9.6	27.0	58.2	0.073	0.17	0.43	980	15.7	0.38	52.4
C	590	67.7	15	68	3.9	247	0.35	36	104	250	70	0.2	3.5	6.3	26.4	63.6	0.069	0.19	0.46	1167	17.4	0.39	52.1
C	591	68.7	20	90	3.7	249	0.58	51	88	263	72	0.3	3.7	4.8	27.7	63.5	0.069	0.15	0.45	1004	16.1	0.39	52.3
C	592	67.7	25	100	3.8	250	1.09	71	65	317	90	1.0	5.0	6.2	28.8	59.0	0.072	0.12	0.34	830	13.4	0.39	51.4
D	639	87.7	15	57	3.0	372	0.26	47	180	160	55	0.1	3.5	5.7	24.4	66.3	0.067	0.27	0.50	1850	26.3	0.48	48.5
D	640	87.7	20	57	3.2	373	0.43	60	139	186	60	0.2	3.8	5.5	24.0	66.5	0.067	0.25	0.42	1900	22.6	0.50	51.1
D	641	87.7	25	57	3.1	374	0.54	69	128	180	70	0.1	3.3	3.8	22.9	69.9	0.065	0.25	0.42	1926	25.8	0.51	49.4
D	648	87.2	35	70	4.0	379	1.04	97	93	198	60	0.3	4.8	3.3	18.5	73.1	0.064	0.14	0.32	1370	19.6	0.46	56.2
Yellow poplar																						
[7]	489	84.9	25	...	3.5	[7]	0.57	47	83	433	120	0.7	15.5	20.8	16.9	46.1	0.089	0.15	0.45	870	..	0.39	62.7
A	534	80.0	15	130	3.1	36	0.96	50	52	365	85	0.4	6.0	8.4	28.0	57.2	0.075	0.10	0.37	656	10.8	0.37	58.0
B	560	70.3	15	100	3.6	85	0.58	44	76	320	57	1.2	7.8	13.2	21.5	56.3	0.077	0.15	0.41	813	12.7	0.38	60.1
C	602	74.0	15	56	3.7	258	0.45	44	99	255	50	0.3	5.4	8.1	24.4	61.8	0.071	0.18	0.43	1135	17.6	0.42	60.4
C	603	72.5	20	90	3.8	259	0.62	52	83	292	58	0.4	8.7	9.4	24.3	57.2	0.075	0.15	0.41	1000	16.1	0.40	59.4
C	604	80.7	25	105	3.7	260	0.97	68	69	318	70	0.6	9.0	7.9	25.1	57.4	0.075	0.13	0.37	812	13.3	0.39	59.8
D	643	83.5	15	57	3.3	375	0.32	46	144	195	30	0.1	5.8	6.6	22.5	65.0	0.069	0.20	0.42	1400	22.0	0.42	57.8
D	645	86.5	20	70	3.0	377	0.43	55	127	222	35	0.2	7.2	7.7	22.1	62.8	0.071	0.19	0.43	1211	19.6	0.40	59.6
D	646	86.6	25	75	3.7	378	0.70	71	102	272	50	0.2	8.5	7.9	21.4	62.0	0.072	0.17	0.40	1068	16.7	0.41	60.5
D	647	85.5	35	80	3.7	378	1.16	94	81	290	50	0.2	8.8	7.5	20.9	62.6	0.071	0.15	0.35	904	14.5	0.40	59.7

[1] Stone surface A was sharp, B was medium-sharp, C was medium-dull, and D was dull.
[2] Basis weight of test sheets, 115 pounds per ream. Test sheets were conditioned at 50% relative humidity and 75°F.
[3] Actual thrust of the pressure foot (determined by calibration of the cylinder pressure) divided by the area represented by the product of the pocket width and wood length.
[4] The pit temperature was 165°F.
[5] A Norton stone 38A90-L10VP was used, except as otherwise noted. Stone service at the start of each run was the accumulative hours of operation (based on three-pocket operation at 3150 feet per minute) since burring with a 10-cut, 1½-inch lead spiral burr and a 14-point diamond burr. Stone immersion was 9 inches. Peripheral speed used in the experiments was 3470 feet per minute. The three pockets were in use simultaneously.
[6] Per square foot of wood-stone contact area.
[7] Made on a Norton 3760/5N7 pulpstone with about 370 hours' service since burring with a 10-cut, 1½-inch lead, spiral burr and a 14-point diamond burr. The surface was considered dull.

Table IV. The Groundwood Pulping of Sugar Maple, Black Tupelo, and White Ash

Stone surface condition[1]	Grinder run No.	Wood dryness, %	Grinding data: Pressure of wood on stone,[3] p.s.i.	Grinding data: Shower-water temperature,[4] °F.	Grinding data: Consistency, %	Grinding data: Stone service time,[5] hours	Grinding data: Grinding rate per 24 hours[6] (moisture-free wood), tons	Grinding data: Power input,[6] hp.	Grinding data: Energy consumed per ton (moisture-free wood), hp.-days	Properties of pulp suspension: Freeness: Schopper-Riegler, ml.	Freeness: Canadian Standard, ml.	Screen analysis: Retained between: Retained on 24-mesh, %	24- and 42-mesh, %	42- and 80-mesh, %	80- and 150-mesh, %	Passing 150-mesh, %	Fiber-length index	Properties of pulp test sheets[2]: Bursting strength (25 × 40 —500), pt. per. lb. per ream	Tearing strength (25 × 40 —500), g. per lb. per ream	Tensile strength lb. per in. width, p.s.i.	Density, g. per cc.	Brightness, %
Sugar maple																						
[7]	480	78.7	35	...	3.8	[7]	1.05	79	75	355	70	0.1	1.8	15.2	23.2	59.7	0.072	0.13	0.34	910	..	0.39	48.1
A	531	76.0	15	125	3.4	33	0.67	43	64	320	90	0.1	0.8	2.2	26.1	70.8	0.064	0.11	0.36	804	12.4	0.39	43.7
B	556	71.2	15	85	3.5	80	0.43	43	100	220	80	0.0	0.7	4.5	30.7	64.7	0.068	0.18	0.34	1140	17.9	0.38	49.6
C	595	78.5	15	56	3.5	252	0.35	41	118	195	120	0.2	0.4	1.0	27.4	71.0	0.064	0.18	0.38	1210	16.7	0.40	41.1
C	594	74.0	20	80	4.0	251	0.67	58	86	280	85	0.1	0.8	2.4	31.6	65.1	0.067	0.14	0.35	805	13.2	0.38	39.3
C	593	73.8	25	95	4.0	250	1.02	72	71	310	80	0.2	1.0	2.2	30.6	66.0	0.067	0.11	0.27	765	12.6	0.38	40.8
D	655	84.4	15	60	2.7	383	0.21	44	205	143	180	0.0	0.4	0.8	24.4	74.4	0.062	0.25	0.36	1876	27.2	0.45	43.3
D	653	84.4	20	58	3.2	382	0.35	53	153	155	148	0.0	0.8	1.0	24.1	74.1	0.062	0.22	0.35	1800	25.7	0.46	44.0
D	652	84.4	25	58	3.2	382	0.55	74	135	183	140	0.0	0.8	1.3	23.3	74.6	0.062	0.18	0.31	1460	21.3	0.45	46.3
D	654	74.8	35	60	3.0	383	1.30	129	95	223	73	0.0	1.0	1.8	28.4	68.8	0.065	0.16	0.35	1211	19.0	0.42	42.6
Black tupelo																						
[7]	487	56.9	30	...	4.8	[7]	1.01	76	75	345	50	0.1	7.2	14.5	15.9	62.3	0.072	0.13	0.37	630	..	0.37	67.5
A	532	82.4	15	115	4.4	34	0.89	47	53	325	65	0.1	4.2	1.2	25.2	69.3	0.065	0.07	0.23	400	6.0	0.39	57.3
B	557	73.6	15	90	3.6	81	0.55	47	85	243	40	0.0	2.6	6.2	20.7	70.5	0.065	0.14	0.29	976	14.5	0.41	58.3
C	599	74.5	15	58	4.0	256	0.43	42	98	228	55	0.1	1.4	2.9	22.5	73.1	0.063	0.14	0.33	914	13.0	0.41	57.1
C	600	75.5	20	85	4.3	257	0.73	62	85	238	40	0.2	1.8	2.8	21.5	73.7	0.063	0.12	0.32	837	13.3	0.39	57.1
C	601	75.9	25	95	3.7	257	0.83	67	81	255	40	0.8	2.7	4.1	23.1	69.3	0.066	0.12	0.31	827	12.9	0.41	57.2
D	644	73.7	15	59	3.0	376	0.24	43	180	160	90	0.0	1.2	1.8	15.1	81.9	0.059	0.17	0.35	1554	22.4	0.44	55.9
D	649	80.3	20	57	3.2	379	0.35	55	155	172	85	0.0	1.1	1.8	16.5	80.8	0.060	0.15	0.31	1512	22.4	0.43	58.5
D	650	75.0	25	60	3.2	380	0.58	71	120	190	70	0.0	1.9	2.2	18.9	77.0	0.061	0.13	0.27	1322	18.6	0.46	58.7
D	651	76.3	35	60	3.5	381	1.23	112	91	258	50	0.0	2.3	2.8	20.5	74.4	0.063	0.09	0.23	874	13.8	0.41	58.4

																				White ash			
[7]	488	75.0	28	...	4.5	[7]	1.29	66	51	483	100	0.0	3.0	16.5	17.7	62.8	0.071	0.09	0.35	1018	..	0.35	61.6
A	533	72.3	15	120	5.0	35	1.04	42	41	355	165	0.0	0.4	1.2	17.0	81.4	0.059	0.03	0.09	183	2.8	0.37	56.4
B	559	82.8	15	95	4.0	84	0.56	38	68	273	180	0.0	0.3	1.4	14.5	83.8	0.058	0.09	0.21	554	8.6	0.38	58.1
C	596	81.3	15	58	4.5	253	0.46	37	81	230	175	0.0	0.2	1.1	17.2	81.5	0.059	0.08	0.26	640	9.5	0.36	57.3
C	597	80.7	20	95	4.6	254	0.80	52	65	260	130	0.0	0.2	1.0	18.4	80.4	0.059	0.07	0.24	438	7.3	0.38	57.0
C	598	79.7	25	105	4.6	255	1.37	70	51	320	95	0.0	0.2	1.2	19.4	79.2	0.050	0.06	0.22	336	5.8	0.37	54.4
D	658	88.5	15	60	4.0	386	0.32	41	127	208	403	0.0	0.5	0.8	11.3	87.4	0.056	0.09	0.19	923	14.2	0.42	57.1
D	656	88.8	20	60	4.7	384	0.50	56	113	205	277	0.0	0.8	0.9	13.7	84.6	0.058	0.09	0.21	850	13.4	0.41	57.0
D	657	88.3	25	60	4.0	385	0.78	69	89	255	178	0.3	1.5	1.4	13.6	83.2	0.058	0.06	0.20	495	8.2	0.38	54.3

[1] Stone surface A was sharp, B was medium-sharp, C was medium-dull, and D was dull.
[2] Basis weight of test sheets, 115 pounds per ream. Test sheets were conditioned at 50% relative humidity and 75°F.
[3] Actual thrust of the pressure foot (determined by calibration of the cylinder pressure) divided by the area represented by the product of the pocket width and wood length.
[4] The pit temperature was 165°F.
[5] A Norton stone 38A90-L10VP was used, except as otherwise noted. Stone service at the start of each run was the accumulative hours of operation (based on three-pocket operation at 3150 feet per minute) since burring with a 10-cut, 1 1/2-inch lead spiral burr and a 14-point diamond burr. Stone immersion was 9 inches. Peripheral speed used in the experiments was 3470 feet per minute. The three pockets were in use simultaneously.
[6] Per square foot of wood-stone contact area.
[7] Made on a Norton 3760/5N7 pulpstone with about 370 hours' service since burring with a 10-cut, 1 1/2-inch lead spiral burr and a 14-point diamond burr. The surface was considered dull.

Table V. The Groundwood Pulping of Pretreated and Untreated Paper Birch and Sweetgum

			Grinding data							Properties of pulp suspension								Properties of pulp test sheets[2]					
												Screen analysis: Retained between											
Stone surface condition[1]	*Grinder run No.*	*Wood dryness, %*	*Pressure of wood on stone,*[3] *p.s.i.*	*Shower-water temperature,*[4] *°F.*	*Consistency, %*	*Stone service time,*[5] *hours*	*Grinding rate per 24 hours*[6] *(moisture-free wood), tons*	*Power input,*[6] *hp.*	*Energy consumed per ton (moisture-free wood), hp.-days*	*Freeness: Schopper-Riegler, ml.*	*Freeness: Canadian Standard, ml.*	*Retained on 24-mesh, %*	*24- and 42-mesh, %*	*42- and 80-mesh, %*	*80- and 150-mesh, %*	*Passing 150-mesh, %*	*Fiber-length index*	*Bursting strength (25 × 40—500), pt. per lb. per ream*	*Tearing strength (25 × 40—500), g. per lb. per ream*	*Tensile strength p.s.i.*	*Tensile strength lb. per in. width*	*Density, g. per cc.*	*Brightness, %*
Untreated paper birch																							
A	527	68.5	15	120	4.5	31	0.65	38	58	420	115	0.1	0.6	1.6	28.0	69.7	0.065	0.05	0.14	295	4.9	0.36	53.9
B	555	70.6	15	80	3.9	79	0.48	44	93	300	110	0.0	1.0	2.9	27.6	68.5	0.065	0.09	0.22	570	9.0	0.38	56.0
C	605	72.2	15	56	3.0	260	0.26	39	153	175	150	0.0	0.5	0.8	22.1	76.6	0.061	0.10	0.30	1100	16.5	0.42	52.5
C	606	69.0	20	70	3.5	262	0.54	55	102	245	80	0.0	1.1	2.7	28.0	68.2	0.065	0.08	0.24	885	14.6	0.39	51.8
C	607	75.7	25	80	3.8	263	0.95	72	76	345	80	0.2	1.9	3.6	28.0	66.3	0.067	0.06	0.22	345	5.9	0.37	51.6
C	608	74.7	25	90	3.8	263	0.86	72	84	345	75	0.2	1.5	4.0	31.0	63.3	0.068	0.07	0.22	482	7.4	0.41	58.1
D	664	82.7	15	60	3.3	390	0.26	46	176	190	100	0.0	0.9	0.9	24.2	74.0	0.062	0.12	0.31	1010	16.1	0.41	55.6
D	661	82.7	20	60	2.6	388	0.33	54	165	210	85	0.0	1.6	2.3	22.8	73.3	0.063	0.11	0.27	1040	16.4	0.40	54.3
D	659	82.7	25	60	3.4	387	0.65	82	127	230	85	0.0	1.6	2.1	22.1	74.2	0.062	0.10	0.24	800	12.7	0.40	53.6
Pretreated paper birch																							
A	529	52.2	15	140	3.5	32	1.08	47	44	727	385	14.9	17.1	19.2	12.9	35.9	0.111	0.11	0.41	567	11.1	0.31	59.5
C	612	44.1	15	75	3.8	268	0.51	48	94	368	95	0.8	13.5	7.3	27.2	51.2	0.081	0.12	0.35	764	12.8	0.38	57.9
C	613	46.1	20	95	3.8	269	0.86	57	65	415	108	0.4	4.0	7.0	28.6	60.0	0.072	0.11	0.30	490	8.3	0.38	56.0
C	614	43.8	25	115	3.5	270	1.55	86	56	520	207	2.7	16.7	10.6	27.4	42.6	0.092	0.11	0.38	464	9.0	0.33	55.8
D	668	48.2	15	100	3.2	392	0.64	48	76	627	580	21.2	26.1	10.3	15.5	26.9	0.134	0.23	0.52	1355	22.8	0.34	55.7
D	666	49.6	20	110	3.8	392	1.09	67	62	655	547	14.9	30.0	7.4	19.2	28.5	0.127	0.25	0.69	1270	23.5	0.36	54.0
D	667	48.0	25	130	3.5	392	1.50	78	52	716	573	24.4	26.0	6.2	14.7	28.7	0.132	0.21	0.70	937	17.7	0.33	56.5
Untreated sweetgum																							
[7]	486	47.7	22	...	5.5	[7]	0.70	49	69	420	95	0.1	4.5	18.3	19.6	57.5	0.075	0.08	0.30	270	..	0.36	48.5
A	526	65.5	15	120	5.0	30	1.04	43	41	415	70	0.2	2.5	3.1	24.7	69.5	0.066	0.04	0.14	260	4.0	0.38	47.9
B	558	71.2	15	95	3.7	82	0.60	44	73	280	50	0.0	1.5	6.2	23.2	69.1	0.066	0.09	0.25	598	9.3	0.38	49.0
C	611	88.3	15	16	3.8	266	0.34	42	123	225	55	0.2	1.7	3.3	23.7	71.1	0.064	0.09	0.28	791	13.1	0.40	44.6
C	609	86.3	20	70	4.0	265	0.65	59	91	265	50	0.0	3.2	4.4	23.1	69.3	0.065	0.08	0.25	660	10.6	0.39	45.5
C	610	85.6	25	85	3.6	266	1.02	79	77	310	45	0.2	3.0	4.6	25.5	66.7	0.067	0.08	0.25	430	7.4	0.37	41.8
D	665	83.5	15	60	3.1	391	0.21	42	195	203	103	0.3	1.5	3.4	18.1	76.7	0.062	0.12	0.25	1310	18.8	0.44	45.2
D	663	85.5	20	60	3.6	390	0 54	68	126	202	58	0.0	2.1	3.1	28.8	66.0	0.067	0.12	0.31	1085	16.6	0.42	48.6
D	662	86.3	25	60	4.2	389	0.99	93	93	255	42	0.0	3.6	3.8	23.2	69.4	0.065	0.09	0.26	765	12.7	0.38	48.1
Pretreated sweetgum																							
A	530	52.7	15	145	4.2	33	1.76	43	24	842	615	23.0	15.4	12.2	8.5	40.9	0.105	0.04	0.30	95	2.1	0.26	53.3
C	616	48.3	15	100	4.4	270	0.80	44	55	680	330	4.9	29.3	8.7	16.0	41.1	0.100	0.08	0.40	331	6.5	0.31	56.9
C	617	49.6	20	115	4.0	271	1.23	60	49	682	322	6.0	17.1	6.9	25.3	43.8	0.091	0.07	0.33	251	5.0	0.31	56.6
C	615	48.9	25	130	4.6	270	2.17	77	36	800	473	9.5	18.1	6.9	24.4	41.1	0.096	0.06	0.26	144	3.0	0.29	53.6
D	669	45.5	15	90	3.8	393	0.68	49	71	740	443	10.2	29.9	10.1	14.6	35.2	0.112	0.09	0.32	366	7.3	0.29	44.1[8]
D	670	47.2	20	100	4.4	393	0.97	60	61	676	373	10.1	26.1	9.1	15.2	39.5	0.103	0.11	0.47	539	10.8	0.32	42.5[8]
D	671	50.3	25	120	4.1	394	1.62	70	43	813	505	12.8	27.3	9.7	15.9	34.3	0.114	0.07	0.34	205	4.4	0.30	44.8[8]

[1] Stone surface A was sharp, B was medium-sharp, C was medium-dull, and D was dull.
[2] Basis weight of test sheets, 115 pounds per ream. Tests sheets were conditioned at 50% relative humidity and 75°F.
[3] Actual thrust of the pressure foot (determined by calibration of the cylinder pressure) divided by the area represented by the product of the pocket width and wood length.
[4] The pit temperature was 165°F.
[5] A Norton stone 38A90-L10VP was used, except as otherwise noted. Stone service at the start of each run was the accumulative hours of operation (based on three-pocket operation at 3150 feet per minute) since burring with a 10-cut, 1 1/2-inch lead spiral burr and a 14-point diamond burr. Stone immersion was 9 inches. Peripheral speed used in the experiments was 3470 feet per minute. The three pockets were in use simultaneously.
[6] Per square foot of wood-stone contact area.
[7] Made on a Norton 3760/5N7 pulpstone with about 370 hours' service since burring with a 10-cut, 1 1/2-inch, spiral burr and a 14-point diamond burr. The surface was considered dull.
[8] These values were obtained on test sheets made several days after the pulp was prepared and are therefore probably lower than if taken on sheets made on the same day the pulp was prepared.

melamine wet-strengthening resin. Data for the book paper machine runs are presented in Table VI, and for the toweling paper runs in Table VII.

DISCUSSION OF RESULTS

Eastern Cottonwood and Yellow Poplar

The grinding data on the Eastern cottonwood and yellow poplar are presented in Table III. These low-density hardwoods had similar grinding characteristics and the pulp properties were similar except for those obtained in series D on the dull stone surface condition. The grinding of both species produced short-fibered pulps containing very small amounts of fiber retained on the 24-mesh screen. Increasing the grinding pressure on the duller surfaces did not increase the proportion of coarser fibers. No difficulty was encountered in grinding these low-density species at 35 p.s.i. with three pockets in simultaneous operation on the dull surface in contrast to the higher-density maple and black tupelo with which there was a decided tendency toward burning in the third pocket even though a top shower was used. It was found that pulps satisfactory for certain furnishes can be obtained from both cottonwood and yellow poplar on various stone surfaces with moderate energy consumption by adjusting the grinding pressure. Cottonwood pulp equal in bursting and tensile strengths to the average of commercial newsprint pulps was produced with an energy consumption of about 90-horsepower days per ton of oven-dry wood. It was indicated that roughly the same results could be obtained with yellow poplar. The yellow poplar pulps were good in color and averaged nearly 60% in brightness whereas the cottonwood was only fair in color, being perhaps in the low range with respect to color of newsprint grade of pulps.

Cottonwood and yellow poplar pulps, runs 482 and 489, respectively, prepared on the dull surface of a Norton 3760/5N7 pulpstone were higher in freeness and average fiber length than the pulps prepared under similar conditions (runs 641 and 646) on the Norton 38A90-L10VP pulpstone, but the pulps made on the two stones were about equal in strength when compared on the basis of equal energy consumption. Cottonwood pulp, run 482, was similar to that reported previously (*1*) except that it was somewhat higher in energy consumption and lower in freeness. The exact cause of these differences is not known and they probably indicate the variations that might be expected under different conditions of grinding and lots of wood having different moisture content.

Sugar Maple, Black Tupelo, and White Ash

The higher-density sugar maple, black tupelo, and white ash ranged from 31.2 to 34.0 pounds per cubic foot (oven-dry weight, green volume). The grinding data on these species are presented in Table IV.

The pulps produced were short fibered with practically no fiber retained on the 24-mesh screen and very little in most cases on the 42-mesh screen. The amount passing the 150-mesh screen was high (60 to 87%) for all three species, with the ash pulps having in general the highest percentages of this fraction and the lowest fiber length indexes. Tests for freeness were, in some cases, inaccurate because of the high percentage of fines in the pulps. In freeness tests of pulps of this character, fines pass through the screen or perforated plate of the testers. This occurs more with the Canadian Standard tester in which the openings in the perforated plate are larger than in the Schopper-Riegler tester.

Pulps of good strength were obtained from the maple in series D on the dull stone surface but the energy consumption was very high and the freenesses low. Pulp about equal in bursting and tensile strengths but lower in tear than an average of a number of commercial newsprint grade pulps was prepared from the maple with a consumption of about 100-horsepower days per ton of oven-dry wood and from black tupelo with slightly higher energy consumption. The color of the maple pulp was dark while that of the black tupelo was good.

The ash pulps were very short fibered, and low in strength, but of fairly good color. The freeness of most of these pulps was probably too low to permit their use in a newsprint type of paper but might be suitable in limited amounts for book and magazine papers. The green ash pulps reported previously (*1*) were slightly higher in bursting strength than the pulps prepared from the white ash in the present work.

The sugar maple, black tupelo, and white ash pulps, runs 480, 487, and 488, prepared on the dull surface of the Norton 3760/5N7 pulpstone and used for book papermaking trials, were higher in freeness, of greater fiber length, lower in energy consumption, and on the average higher in strength than those prepared later on the dull surface of the Norton 38A90-L10VP pulpstone.

Treated and Untreated Paper Birch and Sweetgum

Table V presents the data on the grinding of paper birch and sweetgum.

The pulps prepared from the untreated woods were short fibered and generally low in strength. As with the other higher-density hardwoods, practically no fiber was retained on the 24-mesh screen and very little on the 42-mesh screen with 57 to 77% passing the 150-mesh screen. The freeness of the pulps was generally low, although some increase was obtained by employing higher grinding pressures. The paper birch pulp was fair in color and the sweetgum was dark. The sweetgum pulp, run 486, used for the book papermaking experiment had higher freeness and greater fiber length, but much lower strength than most of the sweetgum pulps prepared later. The lower strength of the pulp is reflected in lower strength in the paper as will be mentioned later.

The grinding of the treated paper birch and sweetgum resulted in pulps of higher freeness and greater fiber length which were produced at higher rates of grinding and at much lower consumptions of energy than those made from the untreated woods under the same conditions of grinding. Pulps made from the pretreated birch were higher in bursting and tearing strengths, as well as in tensile strength in some instances, than those made from the untreated wood. On the other hand, the pretreated sweetgum pulps had about the same low strength as the untreated sweetgum pulps even though the pulps differed greatly in energy consumption, freeness, and screen analysis.

The color of the preheated wood pulps was, on the average, about the same as that of the untreated wood pulps. The brightness of pulp test sheets prepared on the day that the pretreated wood pulp was made was up to 10 percentage points higher than that of sheets prepared several days later. Therefore, it would be desirable to dewater or wash the pulp shortly after grinding if color is important.

Some of the pulps prepared from the pretreated woods were coarse, though not shivey, as indicated by their freeness and screen analysis. In view of the high freenesses obtained on the dull stone surface, it is indicated that pretreated wood can very likely be satisfactorily ground on much duller stone surfaces than are ordinarily used. Though the surface condition D was too dull for grinding most of the seasoned untreated hardwoods studied, it still appeared to be too sharp for the treated woods. As an indication of possible strength development with these high-freeness pulps, a mixture of equal parts of paper birch pulps from runs 666 and 667 was found, after beating in a laboratory beater, to have been increased in bursting and tensile strengths to values equal to those of spruce groundwood of comparable freeness.

PAPERMAKING EXPERIMENTS

In the groundwood book papermaking experiments, there was considerable variation in stock freeness in the different runs but no significant differences in machine operation were observed. The bursting and tensile strengths of papers containing 60% black tupelo, sugar maple, white ash, cottonwood, and yellow poplar ranged from 5 to 20% lower than those of the paper containing the same amount of pine groundwood used for comparison (M.R. 2736), but the paper containing the sweetgum groundwood was about 45% lower in these properties. The papers containing hardwood groundwoods (with the exception of that containing sweetgum) were about equal in bursting strength to a book paper furnish (M.R. 2601) consisting of commercial spruce and aspen groundwood and bleached sulphite pulps. Their tensile and tearing strengths were somewhat higher than this standard, probably because of their content of bleached sulphate pulp. The results indicate that the development of a base paper for coating having satisfactory strength by combining hardwood and softwood groundwoods and chemical pulps is highly possible.

The brightness of the papers containing black tupelo, yellow poplar, and white ash groundwoods were about equal to or higher than those containing the pine groundwood, while those containing sugar maple, sweetgum, and cottonwood were considerably lower. The brightness of the paper made in these runs was in almost every instance about equal to that of the groundwood pulp used even though 40% of the furnish consisted of bleached sulphate pulp of relatively high brightness. Improved brightness in these papers would undoubtedly have resulted if the groundwood had been bleached. Studies on the bleaching of these groundwood pulps have been reported *(5)*. The hardwood groundwood papers were fairly comparable to the standards in density, gloss, and opacity.

In the experiments on paper toweling, the absorbency of either the nonwet-strengthened or the wet-strengthened papers was not altered much by substituting untreated birch groundwood for half of the spruce groundwood, but complete substitution resulted in considerable decrease in absorbency. These results are not in full agreement with the former experiments *(1)*, which showed an appreciable improvement in absorbency of a nonwet-strengthened toweling when about half of the spruce groundwood was replaced with birch groundwood. A substitution of all the spruce groundwood with pretreated birch groundwood had little effect on the absorbency of the nonwet-strengthened papers but caused an appreciable increase in absorbency in the wet-strengthened papers.

The dry bursting and tensile strengths of the toweling papers containing birch groundwood were about equal to those containing spruce groundwood but the tearing strength was lower. The wet tensile strengths were increased in all of the furnishes by the addition of 2% melamine resin to the beater, but the water absorbency was decreased considerably. The color of the paper containing the birch groundwood was about equal to that of the standard spruce groundwood toweling. Several samples of the paper were submitted to a manufacturer of toweling paper for embossing and folding. Though the results of these tests were not entirely satisfactory, because at the time the machines were adjusted for handling a stiffer toweling paper, the comments made on the experimental papers, however, were favorable with respect to their softness and the likelihood that such paper would be acceptable commercially.

CONCLUSION

Though the groundwood pulps obtained from both low- and high-density hardwoods are lower in strength than pulps prepared under comparable conditions from the commonly used softwoods, these tests indicate that they can be blended with stronger pulps and made into acceptable papers. Without bleaching some of them would have limited use in the whiter papers.

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TAPPI Survey of Water Technology

Review of the Literature for 1947

HARRY E. BALDWIN

Quality of the water supply is an important item in the management of paper mills. It plays a large part in the quality of the finished paper. The increasing use of paper and paper products in food wrappers, milk containers, bottle caps, and other similar products demands increasing attention to the methods of water sterilization and the production of a portable water supply for the paper mill. The ever-increasing demands of industry upon the available water supplies of the country necessitate the most careful economy in obtaining the maximum use of plant waters. Iron and manganese, algal growths, etc., affect the color, odor, and tastes of the water supply. Excessive color in the water supply causes an inferior quality product. Excess hardness will also affect the operating efficiency of boilers and cause scale formations in the pipe lines which lead to increased production costs. In this paper an attempt will be made to review the most important papers relating to these problems of water supply and the methods used to solve them as reported in the literature of the water treatment field during 1947.

A. IRON AND MANGANESE REMOVAL

Much emphasis has been placed on the removal of iron and manganese from water supplies during the past year. Manganese is found in appreciable quantities in the Middle West and in the Great Plains regions (*A-1*). Usual methods for manganese removal have included: (a) coagulation at high pH values followed by filtration; (b) filtration through a base exchange material adapted for manganese removal; (c) aeration and contact with manganese ores followed by filtration; (d) aeration, contact filtration, settling, and sand filtration with or without chlorination. Very recently, at Baltimore, Edwards and McCall have reported that manganese and iron can be removed successfully by free residual chlorination at normal pH values without elaborate treatment facilities (*A-2*). Ammonia content of water retards and inhibits removal of manganese until a free chlorine residual is obtained. Manganese can be removed from water by filtering through sand that has been partially coated with manganese dioxide (*A-3*). At Beckley, W. Va., Olean, N. Y., and Durham, N. C., iron and manganese are removed by free residual chlorination (*A-4*). The presence of manganese favors the growth of algae (*A-5*). At Rahway, N. J., chlorine dioxide is used at the prechlorination point for manganese removal (*A-6*). S. B. Applebaum discusses at some length and in some detail the troubles caused by iron and manganese in water supplies and the various methods used for removal of them (*A-7*). In Connecticut chlorine is used for many purposes including iron and manganese removal (*A-8*). The removal of iron and manganese is quite important to the textile industry (*A-9*). St. Joe Paper Company, Port St. Joe, Fla., used chlorination to oxidize iron and improve the color of its paper (*A-10*). The effect of copper and activated silica on iron and manganese removal has also been discussed (*A-11, A-12*). In a review of the progress of breakpoint chlorination, A. E. Griffin discussed the progress in extending the uses of chlorine from that of disinfection to: control of tastes and odors, aids to coagulation, removal of iron and manganese, slime control, and killing of algae (*A-13*). Iron removal plays an important part in water treatment practices in Wisconsin and Maine (*A-14, A-15*). Two other articles on the behavior and treatment of iron-bearing waters and experiments on removal of iron from water are worthy of mention (*A-16, A-17*).

Harry E. Baldwin, Tech. Service Div., Wallace & Tiernan Co., Inc., Newark 1, N. J.

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B. DISINFECTION OF THE WATER SUPPLY

As previously stated, the increasing use of paper and paper products in food wrappers, containers for milk products, beverages, bottle caps, etc., necessitates increasing attention to the use of sterile water in the paper mill. Since all plants must furnish potable water for drinking purposes to their employees, a review of methods for obtaining it appears to be in order.

One of the main purposes of the use of chlorine in water treatment is disinfection. The effectiveness of chlorine compared with that of ozone in the treatment of water has been the subject of several discussions in the current year's literature (*B-1, B-2, B-3, B-4, B-5, B-6*). It is pointed out in these discussions that ozone gives no residual protection to the water and is quite expensive in its application. The only large installation in the United States is one in Philadelphia, and it is not yet in operation. Although ozone is used rather extensively abroad, it has not been very widely approved in this country. Two articles discussed the use of iodine in water sterilization but, except for isolated cases, there is not a widespread use of iodine for this purpose (*B-7, B-8*). A new disinfectant for water supplies, silver *p*-amino benzene sulphonate, has been introduced but is still a laboratory oddity and too expensive for extensive use in this field (*B-9*). In a discussion of contemporary chlorination practices, Harry A. Faber shows how chlorination has produced perfectly sterile water at Fredericksburg, Va., at Waterford, N. Y., and many other places (*B-10*). The effect of chlorination on the virus of *Eastern equine encephalomyelitis* was discussed (*B-11*). It was shown that if breakpoint chlorination was used, the virus was completely inactivated. Other water-borne epidemics were discussed in the literature including: the 1946 cholera epidemic in Russia (*B-12*), the report of typhoid fever in the U. S. in 1945 (*B-13*), the typhoid fever health problems in Uruguay (*B-14*), and Okinawa water treatment for prevention of amoebic dysentery (*B-15*). It was shown that, with proper care, chlorine could be used successfully to eliminate these diseases entirely. The typhoid fever, which alone was responsible for many deaths a few years ago, has been almost eliminated from the United States, chiefly because of the care exercised in water treatment. Prechlorination has played a large part in water treatment (*B-16*). In-plant chlorination in canneries (*B-17*) and in fish packing plants (*B-18*) has resulted in much greater sanitary efficiency in the United States. Chicago has made rapid strides in modernizing their water supply (*B-19*). A highly mobile complete water purification unit has appeared on the market (*B-20*), making it possible to carry emergency water purification to places heretofore inaccessible. Although a flood in Rutland, Vt., disrupted electric, gas, and water supply services, chlorination was used on all water supplies, and there was not a single case of illness traceable to water-borne disease (*B-21*).

The use of other methods of water treatment including: iron salts as coagulants (*B-22*), ionized silver for flocculation and sterilization (*B-23*), electronic principle of water purification (*B-24, B-25*), and electrical water purification (*B-26*) are all discussed in the literature, but so far their use is greatly restricted. Special qualities of electrolytic hypochlorite for sterilization of water supplies were discussed in one article (*B-27*) but the method is not likely to be adopted for large-scale practice.

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C. SLIME CONTROL

A very important and timely subject in current literature is slime control. The use of chlorine in slime control is becoming of increased importance. Canning plants, fish plants, and other food processors have found chlorine quite helpful in slime control (*C-1, C-2*). Harry A. Faber (*C-3*), A. E. Griffin (*C-4*), and J. R. Sanborn (*C-5*) all discuss the use of chlorine in slime control. Los Angeles, Calif., Wichita, Kan., San Francisco, Calif., Rose Valley, Calif., and other municipalities use chlorination for control of slime in transmission lines (*C-6*). A report of the study of slime control in the laboratories of the Paper Institute contains a comparison of some eighteen disinfectants (*C-7*).

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D. MEDICATION

One study of the iodine content of water and its effect on the occurrence of goiter in Russia was published (*D-1*). This brings about a discussion of the question of medication of public water supplies. Some experiments with the addition of iodine to water supplies some twenty-five years ago were mentioned in an article discussing the feasibility of fluorination of water supplies to reduce incidence of dental caries (*D-2*). Much discussion of fluorine in water supplies is found in the current literature (*D-3, D-4, D-5, D-6*).

Some cities are now adopting fluorination as a part of their water treatment processes while others are waiting for more complete, favorable evidence of its success. One article describes the danger of an excessive amount of fluorine in the water supply and describes the use of bone for its removal (*D-7*). It seems that it is still a little early to become overly enthusiastic about this additional treatment practice especially since there is so much conflicting evidence, relative to its merits and demerits being presented in the literature.

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E. MAIN STERILIZATION

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F. TASTE, ODOR, AND COLOR REMOVAL

This topic is one of very great importance in the paper mill industry. More and more operators are beginning to realize that good, clean, colorless water is a necessity if a good, high quality product is desired. Tastes, odors, and colors can arise from various sources. Iron and manganese contribute to the color problem but this phase of the subject has already been covered. Paper mills a few years ago could be built on the bank of a river, take rather clear water from the river, use it in the mill, and discharge the waste water back into the river. Little thought was then given to the treatment of water. However, with the increasing number of factories with their increased demand for water and the increased discharge of industrial wastes to the river, the picture has changed drastically. Now, almost every paper mill finds that water treatment is one of its great problems.

S. E. Edwards and J. B. McCall used chlorine, ferrous sulphate, and activated carbon to control these problems at Baltimore, Md. (*F-1*). In Jamestown, R. I., swampy tastes and odors were almost always present. Chlorine and ammonia, coagulation, settling, and filtering failed to remove the taste. Breakpoint chlorination was tried but was not successful. Chlorine dioxide was tried. Two parts per million chlorine added before coagulation, then chlorine dioxide added just before filtration efficiently removed all tastes and odors (*F-2*). Norman J. Howard discussed the progress in treatment of water for taste and odor correction (*F-3*). He favors superchlorination, discusses use of chlorine dioxide, and recommends activated carbon applications during periods of rapid algal growths. In the new filtration plant at Midland, Pa., provision is made for both pre- and post-chlorination.

Alum and lime are used for coagulation but activated carbon is necessary to eliminate tastes and odors (*F-4*). Jacobson and Wellington report that free residual chlorination has improved the taste and odor of water supply at New Haven, Conn., and permits a more uniform scientific method of control (*F-5*). In a review of water treatment practice in Massachusetts, Joseph A. McCarthy tells of various problems of color and odor reduction (*F-6*). At Chicopee the problem of high color and airfield oily drainage complicates the treatment. It is found that both chlorine and chlorine dioxide are necessary to control tastes and odors. At Presque Isle they have starch waste fermentation which causes all types of treatment to fail in the attempt to produce palatable water. At Bangor, paper mill wastes and sewage complicate the problem but pre- and post-chlorination together with alum, lime, aeration, sedimentation, carbon, and rapid sand filtration combine to produce a palatable water supply. Color is greatly reduced. Chlorine dioxide has been used by a number of Canadian water treatment plants for removing tastes and odors (*F-7*). It is shown to be more economical to satisfy the chlorine demand with chlorine and then use chlorine dioxide to remove tastes and odors. This treatment has been used quite successfully at New Toronto, Scarboro, and Wallaceburg, Ont., and at Camrose, Alta. In many cases it has eliminated the necessity of carbon treatment. The use of ozone for this purpose is discussed by Victor Hann (*F-8*). Although used for over forty years in Europe it has not been widely used in the United States. In Connecticut chlorine is used for taste and odor control, bleaching and color reduction, and many other purposes (*F-9*). Chlorine dioxide is not used in Connecticut. Howard E. Bailey and James Studley discussed the use of copper sulphate combined with activated carbon in the Great Sandy Bottom Pond at Pembroke to eliminate turbidity, tastes, and odors (*F-10*). R. N. Aston describes the use of chlorine dioxide in taste and odor control in water treatment plants along the Niagara border (*F-11*).

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G. SPECIAL TREATMENTS OF WATER FOR PAPER MILLS

In a paper entitled "Modern Water Chlorination," L. L. Hedgepeth reviews the chlorination practices and their application to the paper mill industry (*G-1*). H. R. Hay discusses the use of activated silica for improving water plant operations (*G-2*). The uses of activated silica and its applications in solving paper mill problems, such as raw water coagulation, color removal, softening, freeness, conditioning of stock, machine operation for fiber and filler retention in the wet web, white water and general mill waste treatments, make it worth the careful consideration of paper mill operators (*G-3*). Coupled with the above uses silica is being used for better sizing, for pH control, to facilitate hydration, to increase stiffness, for hypochlorite or peroxide bleaching, for deinking, and for decreasing wax penetration.

White water treatment is a very important phase of the paper mill operation. One phase of white water treatment concerns the recovery of fiber. H. R. Clodfelter describes a method of fiber recovery by flotation (*G-4*). Allen Strang discusses a similar scheme of fiber removal and some reuse of the water (*G-5*). Arthur Thurn in an article dealing with the cost of water treatment in paper mills discusses treatment and reuse of white water and savings affected thereby (*G-6*). The Downingtown mill has made considerable improvement in water clarification process (*G-7*). Clarification of white water by the use of the Marx (saveall) filter is discussed (*G-8*). Considering the fact that each separate plant presents a specific problem, the variations and similarities of paperboard mill white waters is stressed in a discussion by Willem Rudolfs and Earl Axe (*G-9*).

Biochemical oxygen demand becomes a new expression for the paper mill operator (*G-10*). At first a paper mill could take clear raw water from a neighboring river and return its waste waters to the river. However, the concentration of industries along the rivers has made this almost impossible. Each paper mill operator must now study the characteristics of the raw water supply for his mill and determine the nature and extent of treatment necessary to insure him a first class paper product. He, also, must study the characteristics of his plant waste waters and bring them up to certain standards before he can discharge them into the river. At a meeting of the Southern Section of the National Council for Stream Improvement it was pointed out that the paper mills were doing an excellent job cooperating with the council in waste water treatments (*G-11*). In a recent paper describing treatment of industrial wastes in Michigan, three methods of paper mill waste water treatment were mentioned (*G-12*). They include flotation, flocculation and sedimentation, sludge blanket, and subsequent chlorination. In the Senate's stream bill, which only reached the House committee, recognition that certain industries have been making honest efforts to perfect methods of stream improvement by proper treatment of their wastes, has been responsible

for a general reluctance to impose drastic legislation upon any industry until that industry has had a fair chance to comply with regulations governing the discharge of such wastes to public waters (*G-13*). In its report the Water Pollution Research Board cited the need of cooperative research by industry and the board to prevent the pollution of surface water supplies by trade wastes (*G-14*).

Feedwater conditioning for use in the boilers of paper mills is becoming an increasingly important subject (*G-15, G-16*). St. Joe Paper Company is softening their water supply for boilers by two-stage Hot-Process Infilco Softeners (*G-17*). Some paper processes are benefited immensely by the use of softened water. There are many articles in the current literature written about this timely topic. See references *G-18–G-32,* and others.

One article dealing with the treatment of water for processing textiles is quite interesting to men who have allied troubles of iron and manganese removal, color reduction, tastes, and odor problems, etc. (*G-33*).

Algae control is especially vital to the water supply of the paper mill. With prolific algal growths we find high color, tastes, and odors. The experience with anabaena in Kenoza Lake at Haverhill, Mass., shows the importance of early treatment (*G-34*). It proves that prevention is much more effective than trying to cope with algal growths which have become well established. Means of algae control are discussed at much length in the literature (*G-35–G-42*). These problems are closely tied in with others and when control of algae is effective, other factors show great improvement.

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Evaluation of Fibrous Agricultural Residues for Structural Building Board Products

II. Fundamental Studies on Wheat Straw Fiber

E. C. LATHROP and T. R. NAFFZIGER

A fundamental study of the relationship between the fiber properties of wheat straw and the physical characteristics of insulation boards made from them has led directly to the conclusion that wheat straw is highly suitable for the manufacture of meritorious products. Methods are described for cooking and refining wheat straw to produce mainly long fibers and also hydrated short fibers. A means of fractionating long straw fibers into various fiber lengths is described. An analysis of the physical properties of insulating boards made from hydrated, filler, and selected long straw fiber has shown that long fibers favor the production of boards of flexural and tensile strengths higher at any comparable densities than wood fiber boards. The impact strength of such boards is two to three times that of wood boards. Tensile strength of such wheat straw boards is directly related to hydrated fiber content, while impact strength is directly related to fiber length, although fiber diameter may also play an important role in impact strength.

Structural insulating building board is now manufactured in the United States at an annual rate of 3 billion square feet ($^1/_2$-inch basis) (*1*). Consumer acceptance of insulating board has increased rapidly during this first 30 years of the industry. This, together with the growing scarcity of lumber and the housing shortage, seems to assure continued growth of the industry—expansion above that to be provided by the manufacturing facilities now under construction.

It is evident that sound commercial utilization of agricultural residues must be based primarily on their ability to render a service superior in quality. This is the plan adopted and consistently followed by the Northern Regional Research Laboratory. Research work, therefore, of a fundamental character is indicated before the more practical aspects of developing a process for building board manufacture is undertaken.

Sugarcane bagasse, wheat straw, cornstalks, licorice root, and flax shives have all been used to manufacture commercially acceptable boards. Of these, sugarcane bagasse, because of its long, tough, springy fiber bundles, has been an outstandingly and preferred raw material. Although a satisfactory board could be made from cornstalks, the high cost of collection was prohibitive. Wheat straw was used for some years as a raw material in an insulating board plant at St. Joseph, Mo. (*2*). This product made from wheat straw was acceptable but was in no way outstanding. The plant was closed down some years ago, partly because of manufacturing problems involving inadequate plant facilities, but also because of quality of product and difficulties of raw material supply. Judging by this single instance, one might conclude that wheat straw is unsuited for the manufacture of insulating board. As will be shown later, this is not true; on the contrary, wheat straw is the equal of and possibly is superior to sugarcane bagasse as a raw material.

In 1923 one of the authors (*3*), then engaged in the commercial development of insulating board products from bagasse, made qualitative observations which correlated physical properties of commercial boards with properties of fiber length and diameter in the furnish to the board machine. These observations were followed up over a period of years during which certain quantitative data relating fiber length and character to the physical properties of board products were established. While these fundamental relationships could only be explored in part, it was shown beyond question that such fundamental studies were a sound guide to the solution of practical manufacturing problems.

PURPOSE AND PLAN OF INVESTIGATION

It is with such a background of fundamental and practical knowledge that the studies reported herewith have been undertaken. Wheat straw represents the residue produced annually in the largest tonnage; it is also the one produced in many different regions and states. It was chosen as the first fibrous residue to be studied for its suitability as a raw material for the manufacture of insulating building board products of exceptional merit. From such information it was expected that a rational process for commercial manufacture could be developed.

Sugarcane bagasse can be processed into a high proportion of long, springy, tough fibers, particularly suited for making high-grade, rugged insulating board products. In the manufacturing operation this long-fibered pulp, the unhydrated component of the furnish, is blended in varying proportions with a hydrated pulp prepared either from bagasse or waste paper. Using bagasse long fibers suitable for board as a reference, it was found possible by a simple cooking and refining process to produce quite similar long, springy fibers from wheat straw. A method was then devised for separating this long-fibered straw pulp into fractions of approximately equal fiber length, as follows: (a)

E. C. Lathrop, Member TAPPI; Chief, Northern Regional Research Laboratory,[1] Peoria, Ill. T. R. Naffziger, Member TAPPI; Chemical Engineer, Northern Regional Research Laboratory, Peoria, Ill.

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

—0.125 inch, (b) 0.125 to 0.25 inch, (c) 0.25 to 0.50 inch, (d) 0.50 to 0.75 inch, and (e) +0.75 inch. Previous tests (*4*) had shown straw pulp as used in the manufacture of 9-point corrugating board was very satisfactory as the hydrated pulp component in making insulating building board from straw.

In order to establish the relationship between fiber length and the physical properties of boards, three series of laboratory boards were made under rigidly controlled conditions in which the percentage of three fiber components were varied in an orderly manner over a wide range. Hydrated pulp and "filler," the (a) —0.125 inch fiber fraction of the unhydrated pulp, were used as two of the components in all series. In one each of the three series the third fiber fraction component was (c) 0.25 to 0.50 inch, (d) 0.50 to 0.75 inch, and (e) +0.75 inch. The familiar triangular diagram was used to portray the results of the studies.

EXPERIMENTAL

Baled soft red winter wheat straw was used in this study. The straw was practically free of weeds, was dry when baled after combining, and was placed in dry storage. The straw was obtained July 27, 1944, near Chillicothe, Ill. It contained 3% chaff.

When sugarcane is milled, the bagasse produced is fairly uniform in fiber length distribution. The fiber lengths depend on the size and number of rolls in the mill. With small mills the bagasse fibers may occur, in part, over an inch in length; with large mills the majority of the fibers are less than an inch. This cutting of the cane into rather uniform fiber lengths is an important preparative step in making bagasse suitable for board manufacture, and is really the first step in fiber length control. The first step in preparing straw was therefore that of chopping to a length of about 1.5 inches. This operation was easily accomplished in an ensilage chopper provided with a set of cutting knives and a hammer-mill attachment. The chopped straw was surprisingly uniform in lengths between 0.5 to 1.5 inches.

Experiments showed a water cook, with a 6:1 liquid-to-solid ratio on dry straw for 1.25 hours at 142°C. (40 pounds steam pressure) in a 3-foot spherical steel digester, produced a satisfactory pulp. An entire bale of straw could be cooked at one time. The water-cooked straw was dumped from the digester, allowed to drain, and to cool.

When the cooled straw was passed through a 24-inch Bauer refiner, dressed with plates B1673 at a clearance between the plates of 0.023 to 0.025 inch, fibers similar to bagasse fibers used for board manufacture were obtained. Approximately 400 pounds of straw were so cooked and refined during this study. It was possible to duplicate the fiber characteristics closely from run to run by keeping the straw at room temperature, feeding it to the Bauer refiner at a constant rate, supplying water to obtain a consistency of pulp of approximately 8%, and bleeding a small amount of steam into the throat of the plates. A standard sample of the fiber desired was floated in a large amount of water in a glass pie-plate and visual comparisons of fiber produced at various clearances of the refiner plates were made. By slight adjustment of the clearance setting, close duplication of fibers was obtained.

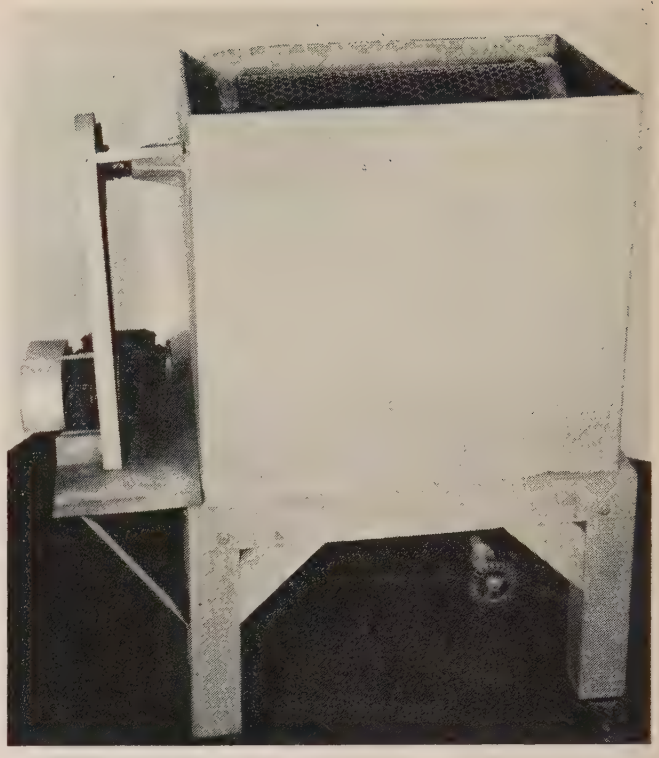

Fig. 1. Fiber fractionator

The pulp from the refiner passed into a rotary washer, the effluent from which was pumped over a hillside screen dressed with 100-mesh wire. The pulp from this screen was added to the washed pulp. The yield of this washed, unhydrated long-fibered pulp averaged 78% on the basis of oven-dry straw. The water-soluble materials in straw amounted to about 15% and fibers passing the 100-mesh screen represented about 7%.

Since it was necessary to keep the pulp in a moist condition for experimental use, the pulp from the washer was treated with commercial ethyl mercury phosphate, then was pressed to about 30% dry content, and stored in cans at about freezing temperature. This method was quite satisfactory for storing moist pulp samples. The presence of this mercury compound had no observable effect on paper or board pulps in so far as physical properties of paper or board samples were concerned.

This long-fibered straw pulp was fractionated into several approximate fiber length classes. The operation was carried out in the fiber fractionator shown in Fig. 1. This consists of a sheet iron vat 29.5 inches long, 20.5 inches wide, and 28.5 inches high. The vat is filled about two-thirds full of water. The pulp to be fractionated is made into a 2% consistency with water. The fractionating screens consist of 22-gage brass plate perforated with round holes as indicated below. The screen is in the form of a cylinder 24 inches long and 12 inches in diameter. This cylinder fits into solid caps at each end, which carry the shaft. One cap is held in place by wing nuts. The fiber to be fractionated is placed inside the perforated cylinder by suspending the cylinder, capped at its lower end, vertically in the vat and pouring the 2% fiber suspension into it. The top cap is locked into place and the cylinder is suspended in a horizontal position on its bearing at the top of the vat. Sufficient additional

water is now added to bring the water level to within 3 inches of the top of the cylinder. The cylinder is rotated for 5 minutes at 25 r.p.m. by a small motor. After 5 minutes the water in the vat is drained onto a 0.04-mesh screen or, in the case of —0.125-inch fiber, into a bag filter. The fiber collected is treated with Lignasan, made into mats, disintegrated, and stored until use as described above.

The fractionator is supplied with four screens, perforated respectively with round holes 0.125, 0.25, 0.50, and 0.75 inch in diameter. The first fractionation step uses the 0.125-screen and removes the —0.125-inch fiber fraction. This step is repeated and the fiber from both separations is collected. The fiber remaining in the 0.125 cylinder is then removed completely and placed inside the 0.25-inch screen and the fractionation operation continued. In turn, the 0.50- and 0.75-inch screens are used. From this fractionation five fractions result (a) —0.125 inch, (b) 0.125 to 0.25 inch, (c) 0.25 to 0.50 inch, (d) 0.50 to 0.75 inch, and (e) +0.75 inch.

Table I gives the yields of these fractions of straw fiber based on oven-dry long-fibered refined pulp.

Table I. Yield of Wheat Straw Fibers of Various Lengths by Fractionation, Based on Moisture-Free Long-Fibered Pulp

Approximate fiber length, inches	*Yield, per cent by weight*
Less than 0.125	10.4
Between 0.125 and 0.25	8.4
Between 0.25 and 0.50	10.9
Between 0.50 and 0.75	22.8
More than 0.75	47.5
	100

The actual size of these various fiber fractions is shown in Fig. 2. It will be noted that while there is some variation in fiber length in each fraction, for practical purposes the separation is satisfactory. It will be seen that there is considerable variation in fiber diameter in the longer fractions. It should be borne in mind that all of these fibers are, in reality, fiber bundles.

The hydrated pulp used in this study was prepared by cooking unchopped wheat straw with 6% calcium oxide and 1.5% sodium hydroxide, in a 7:1 liquid-to-solids ratio on the basis of moisture-free straw, for 5 hours at 142°C. (40 pounds steam pressure). The cooked straw was defibered and washed in a 5-pound Noble and Wood beater equipped with a washer drum with the beater roll raised from the bed plate. The beater roll was then lowered and the pulp was beaten at 2% consistency to a freeness of 400 S.R. The yields of washed pulp are 70 to 75% on the basis of oven-dry straw.

In the manufacture of insulating boards three rather definite fiber components may be recognized, e.g., filler fibers of which the —0.125-inch length fibers are representative, hydrated fiber, and long fiber. Short filler fibers are always produced in mechanical refining operations. In limited quantities such fibers serve a useful purpose, but in excess they lead to weaker and denser boards. In general, it is more difficult to limit the amount of filler fiber in processing wood.

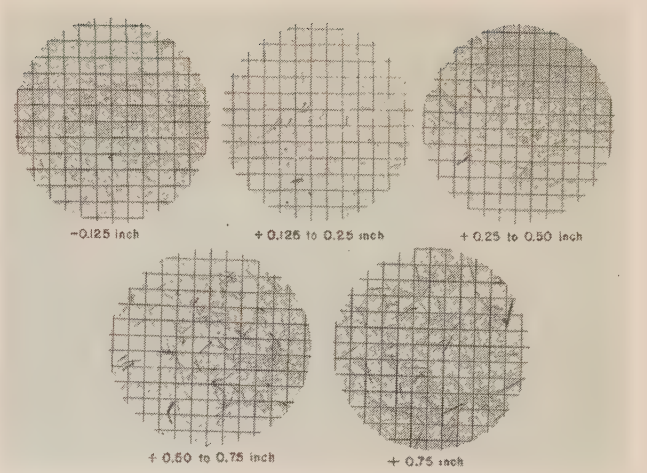

Fig. 2. Various fiber fractions

In order to determine the effects of each of these components, three series of boards of three components each were made using the equipment and methods previously described by the authors (*4*). The first of these series of boards was composed of zero to 70% filler fiber (—0.125 inch in length), zero to 70% of long fibers +0.75-inch, and zero to 45% hydrated fiber. In the second series of boards, fibers 0.50 to 0.75 inch long were substituted for the +0.75-inch long fibers. In this way it was possible to obtain a direct comparison of the +0.75-inch and 0.50-inch long fibers as related to physical properties of the boards. After this study was completed a less complete series of boards was made in which the long-fiber component consisted of fibers 0.25 to 0.50 inch long. The wet boards were pressed to a moisture content of 70% and were dried in a hot air oven at 103°C. to constant weight.

In making the boards in this study the fibers were made to 0.5% consistency before board formation. It was found that to obtain closely replicating results it was necessary to prepare each fiber component separately to this consistency and pour the three suspensions together into a container under vigorous agitation. This became all the more important when blending small amounts of one component with the other two components.

Physical tests on the boards were then made by the methods described by the authors previously (*4*).

DISCUSSION OF RESULTS

Using triangular diagrams, tie-lines representing equal physical properties as determined on each of the series of boards were plotted. The physical properties so plotted are density, tensile strength, flexural strength, and impact strength.

Density

Figure 3 shows the variation in density as influenced by fiber composition in making boards from each of the three types of long fiber. The tie-lines for each density originate at a common point on the right of the triangle where only two components are present, namely —0.125 inch and hydrated fiber. From these points the tie-lines fan out in an orderly manner as they approach the left side of the triangle where the

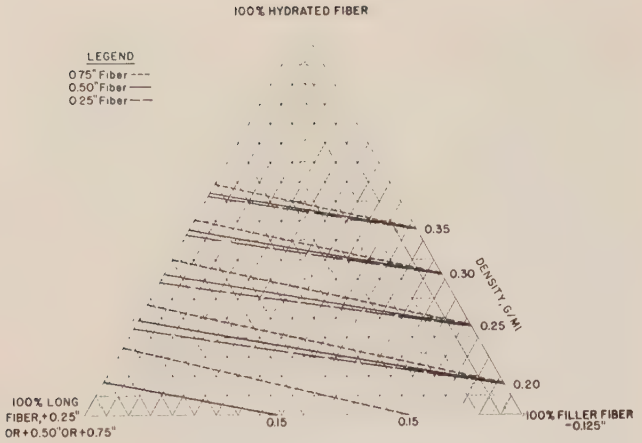

Fig. 3. Fiber composition—density relationships

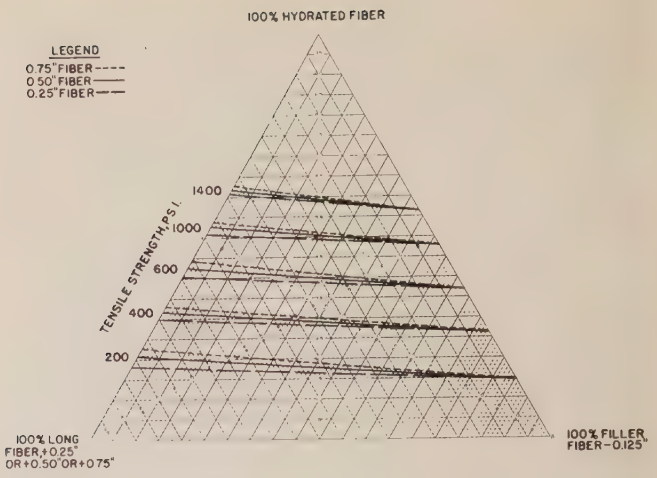

Fig. 5. Fiber composition—tensile strength relationships

two components are the hydrated and long fibers. These curves show that the longer fibers require more hydrated fiber to produce boards of equal density. This difference increases as density decreases. This means that when using the same percentage of hydrated fiber, boards made with the +0.75-inch fiber will have the lowest density. This is of great importance, since the problem of insulation board manufacture is to produce the lightest weight board with adequate strength. It is evident from this discussion and from the tie-lines in Fig. 3 that to produce boards with a density of much less than 0.150 g. per ml., +0.75-inch fibers will be required. The curves show that, as the proportion of —0.125-inch fiber is increased, less hydrated fiber is required to produce boards of equal density, and, further, that boards of much less than 0.20 cannot be produced with high percentages of this filler fiber.

Flexural Strength

The fiber composition-flexural strength relationships are shown in Fig. 4. Again the families of tie-lines fan out from the right to the left side of the triangle; the longer the fiber components, the more hydrated fiber required to produce boards of equal strength.

In the lower flexural strength ranges the proportionate amount of hydrate fiber to produce boards of equal strength increases with fiber length. In all cases, using the same percentage of hydrated and filler fiber, the +0.25-inch fibers produced boards of the greatest strength.

Tensile Strength

The relationships between tensile strength and fiber composition are shown in Fig. 5. The same general conclusions may be drawn as with the flexural strength relationships. It will be noted that the tie-lines for tensile strength are very nearly parallel with the lines of the triangular diagram of equal percentages of hydrated fiber. In other words, the tensile strength of the boards is nearly directly proportional to the percentage of hydrated fiber in the board. Referring back to Figs. 4 and 5, it will be seen that the effect of amount of hydrated fiber on density and flexural strength is not so pronounced as on tensile strength. Table II gives the slope of the respective tie-lines in Figs. 3, 4, and 5 and portrays in a qualitative way the effect of hydrated fiber on board properties.

Impact Strength

In turn Fig. 6 shows the relationship between fiber composition and impact strength of the boards made. The tie-lines in this case take an entirely different form. It is evident that impact strength is not closely related to hydrated fiber percentage but to the percentage and the kind of long fibers present. The striking effect of the +0.75-inch fibers in producing boards of high impact strength is clear.

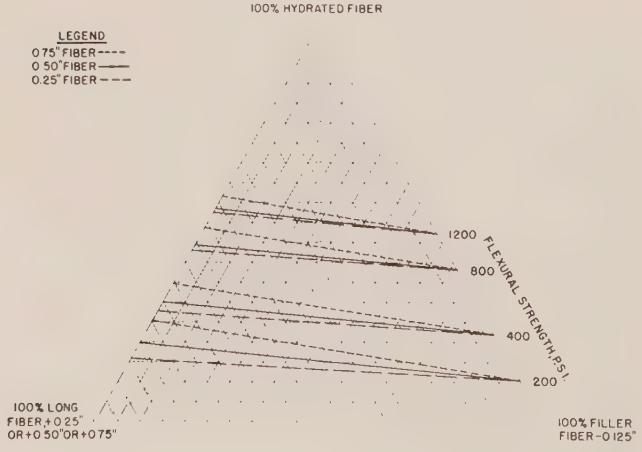

Fig. 4. Fiber composition—flexural strength relationships

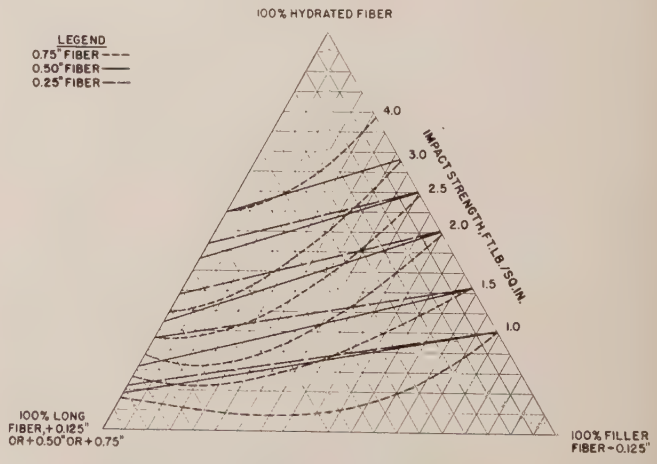

Fig. 6. Fiber composition—impact strength relationships

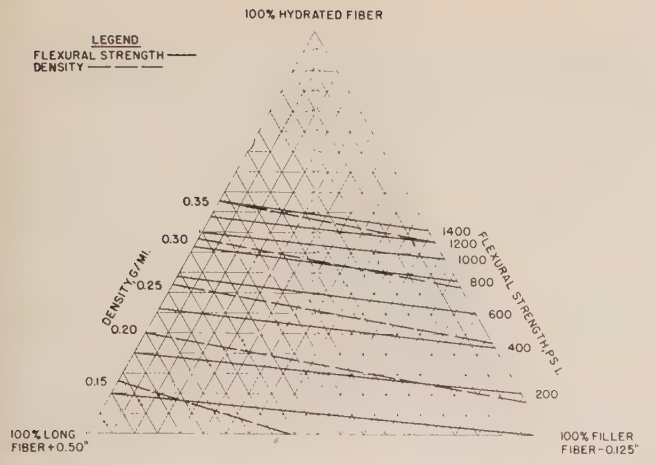

Fig. 7. Density—flexual strength relationships for +0.50-inch fiber

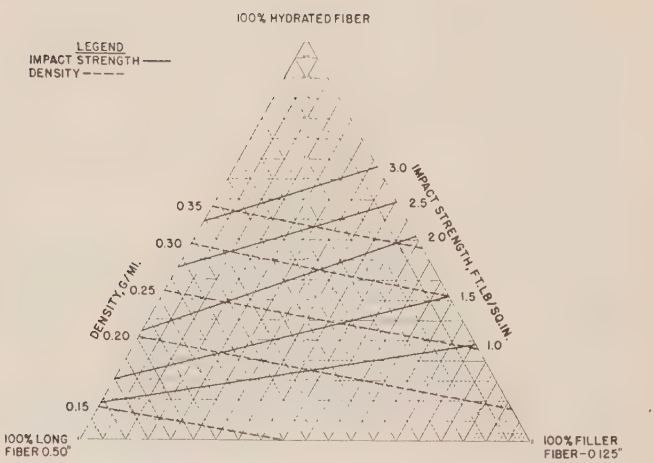

Fig. 9. Density—impact strength relationships for 0.50-inch fiber

This effect of fiber length on impact strength is to be anticipated; it is observed in boards made for the box industry, where kraft boards show greater impact strength and tear resistance than boards made from shorter-fibered pulps; in the manufacture of high impact resistant plastics long fibered fillers or woven textiles are used. The phenomenon is probably due to several causes, chief of which may be the fact that the longer fibers, in felting, have many more fiber-bonding contacts than the short fibers and thus produce a more rigid, rugged and tear-resistant structure. The effect of fiber diameter may also be important. The +0.75-inch fibers are considerably coarser than the +0.25-inch fibers. This study has not been directed particularly to a study of the effects of fiber diameter on board properties. Since it is possible to produce long and thin fibers from agricultural residues, it is proposed to make the effect of fiber diameter on impact strength the subject of a future study.

Table II. Slope of Density, Flexural, and Tensile Strength Tie-Lines in Figs. 3, 4, and 5

	+0.75-in. Fiber	*0.50–0.75-in. Fiber*	*0.25–0.50-in. Fiber*
Density value, g./ml.	Density tie-lines		
Less than 0.15	12.5°	10.0°	
0.15–0.20	12.5°	9.5°	8.0°
0.20–0.25	12.5°	9.5°	8.0°
0.25–0.30	12.0°	9.5°	8.0°
0.30–0.35	12.0°	9.5°	8.5°
Flexural value, p.s.i.	Flexural tie-lines		
200	9.0°	5.5°	3.5°
400	9.0°	5.5°	4.0°
800	9.0°	5.0°	4.0°
1200	9.0°	6.0°	5.0°
Tensile value, p.s.i.	Tensile tie-lines		
200	6.0°	4.5°	3.0°
400	6.0°	4.5°	3.0°
600	6.5°	5.0°	3.0°
1000	7.5°	6.0°	4.5°
1400	8.0°	6.5°	5.5°

Because of the physical structure of straw and certain other fibrous residues it is possible to produce long, coarse fiber bundles. So far it has not been possible to produce similar fibers from wood. From the information obtained in the present study, the outstanding value of these fibers lies in their ability to produce insulating board of much higher impact strength than is possible in boards now produced from wood. The present maximum impact strengths observed in wood fiber boards is in the neighborhood of 0.40 to 0.70 ft.lb. per sq.in. Moreover, the density of such boards lies in the range 0.25 to 0.325. From Fig. 6 it is evident that boards can be made from straw in a much lower density range with impact strength values two or three times that of the best products from wood.

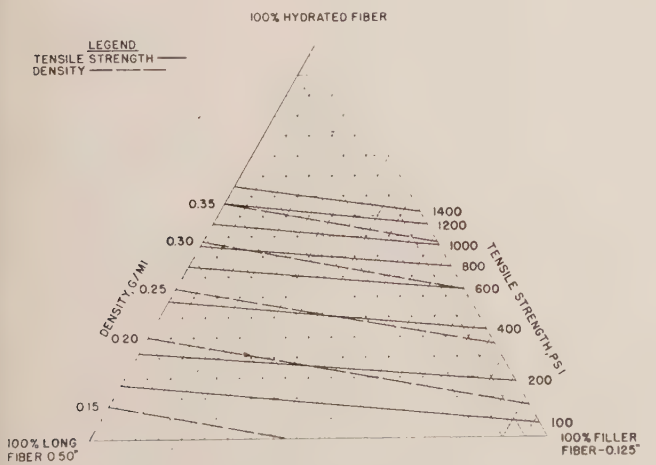

Fig. 8. Density—tensile strength relationships for 0.50-inch fiber

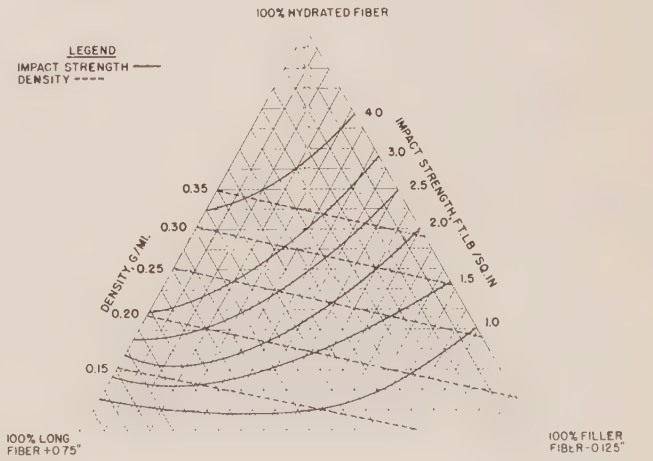

Fig. 10. Density—impact strength relationships for +0.75-inch fiber

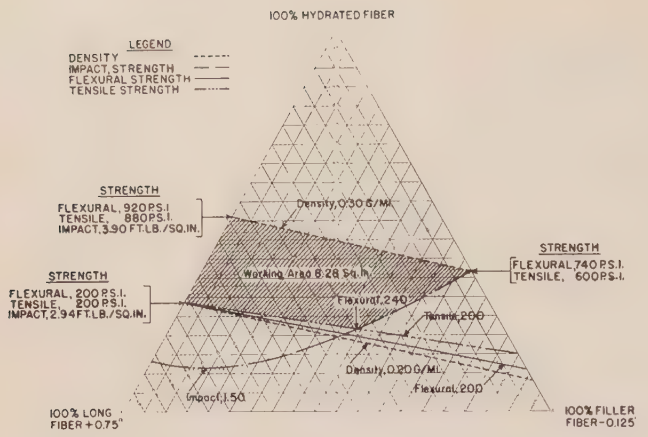

Fig. 11. Operating area using 0.75-inch fibers

Impact resistance is associated with ruggedness. Products produced from long straw fibers resist "dog earing" of corners and rough handling to a remarkable degree. Ruggedness is particularly important in handling boards in large sheets or for many industrial purposes.

Relationship between Density and Strength Properties

Figures 7, 8, and 9 show the relationships between density and flexural, tensile, and impact strength for boards made with +0.50-inch long fibers. At equal densities, flexural, tensile, and particularly impact strength increases as the proportion of long and of hydrated fiber increases. Thus long straw fibers make possible the fabrication of insulating boards of low density and high strength. Figure 10 shows the relationship between density and impact strength of boards made with +0.75-inch fibers. Figure 10 is to be compared with Fig. 9. This comparison again brings out the striking effect of long fibers in contributing to high impact strength in insulating boards.

Practical Applications

From the data presented it is clearly possible to predict board properties from fiber composition. Therefore, specifications for physical properties may be set up, and from the data obtained in this study fiber compositions may be selected which will produce boards meeting these specifications. The area within the triangular diagram in which all the specifications are met will then be the range of fiber compositions

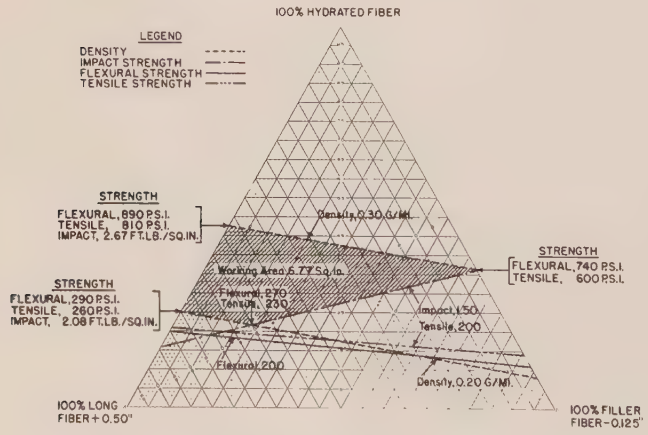

Fig. 12. Operating area using +0.50-inch fibers

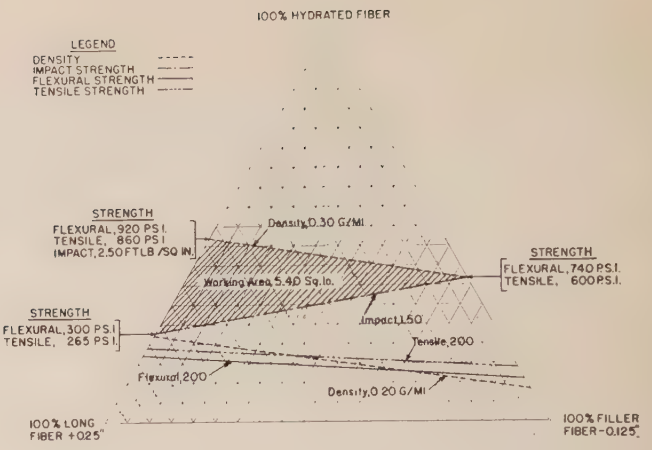

Fig. 13. Operating area using +0.25-inch fiber

required for mill operations. This has been borne out in actual mill practice. It is obvious that the larger this operating area, the greater the ease of operating.

In Figs. 11, 12, and 13 tie-lines are drawn for +0.25-inch, +0.50-inch, and +0.75-inch long fiber boards, respectively, which will meet the following specifications: Density 0.20 to 0.30, flexural strength 200 p.s.i. minimum, tensile strength 200 p.s.i. minimum, and impact strength 1.5 ft.lb. per sq.in. minimum. Visual inspection of the curves in Fig. 11 shows that the operating area of boards made with +0.75-inch fibers is the greatest, while the operating area of boards made with +0.25-inch fibers (Fig. 13) is the smallest. The operating area of the +0.50-inch fiberboards is only 82% of that of the +0.75-inch fiberboards and the +0.25 inch only 64%. The +0.25-inch fiberboard operating area is but 80% of the area of the +0.50-inch fiberboard. The specifications discussed are considerably higher than the minimum strength specifications accepted in commerce at present. From the data given it is possible to produce a stronger board at lower density, using the +0.25-inch fiber, than the present boards on the market using wood.

Reference to Table I shows that 80% of the unfractionated unhydrated straw fiber consisted of lengths of +0.25 inch to +0.75 inch. Inspection shows that the average fiber length of this 80% fraction is greater than 0.50 inch. The operating area for making boards from the unfractionated fiber will therefore be greater than that for the +0.50-inch fiber (Fig. 12) and somewhat less than that for the +0.75-inch fiber (Fig. 11). Furthermore, since the —0.125-inch fiber constitutes of only 11%, together with about 9% of fiber of a length between 0.125 inch and 0.25 inch, boards made will fall well to the left of the diagram. Again, inspection shows that such boards will possess high strengths at any comparable density, particularly impact strength. Straw may therefore be used for the manufacture of insulating building board products of exceptional merit.

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RECEIVED July 12, 1948. Presented at the Annual Meeting of the Technical Association of the Pulp & Paper Industry, Hotel Commodore, New York, N. Y., Feb. 21–24, 1949.

UNITED STATES PATENTS ON PAPERMAKING

Third Quarter, 1948

Compiled by CLARENCE J. WEST

THE following list of patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture.

Copies of any of the following patents can be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

The previous lists of patents for 1948 appeared in *Paper Trade Journal* 126, No. 17: 59–60 (April 22, 1948), and 127, No. 6: 55–57 (Aug. 5, 1948).

July 6, 1948

2,444,412. Mannogalactan mucilages and process for producing same. John W. Swanson, assignor to the Institute of Paper Chemistry, Appleton, Wis. Filed March 19, 1945. 10 claims. (Cl. 260–209.) Mannogalactans from flame tree, guar seed, tara seed, and locust bean are treated in borax solution with chlorine; the purified product is suitable for tub sizing and as an adhesive for coating paper.

2,444,443. Composite flexible moistureproof wrapping tape or sheet. Charles F. Hesselroth, assignor to Minnesota Mining & Manufacturing Company, St. Paul, Minn. Filed Feb. 10, 1943. 2 claims. (Cl. 154-50.) The material consists of Walpole 35-lb. crepe paper embedded in microcrystalline wax laminated to a cellulose acetate film and coated with a thin wax film. The thickness of the assembly is approximately 0.015 inch.

2,444,496. Box sealing machine. Christian Christiansen, assignor to Rotary Machine Company, Inc., Lynn, Mass. Filed June 1, 1944. 5 claims. (Cl. 93-36.3.) A device for sealing under high pressure the folded glued flaps of box blanks.

2,444,497. Hollow-walled carton structure. John D. Clarke, assignor to Morris Paper Mills, Chicago, Ill. Filed Sept. 11, 1944. 6 claims. (Cl. 229-34.) The bottom panel is equipped with hollow side walls provided by panels which form inner and outer wall sections connected by a top spacer section.

2,444,515. Carton assembling machine. Leon E. La Bombard, assignor to The International Paper Box Machine Company, Nashua, N. H. Filed Dec. 23, 1944. 24 claims. (Cl. 93-55.1.) The apparatus is designed for assembling a carton, such as an ice cream container.

2,444,623. Shingle. Herbert Abraham, assignor to The Rubberoid Co., New York, N. Y. Filed Nov. 27, 1945. 3 claims. (Cl. 108–7.) A design for a roofing shingle.

2,444,668. Method of and apparatus for providing a response to the consistency of papermaking stock. Ernest A. Poirier, Waterville, Maine. Filed March 6, 1943. 13 claims. (Cl. 137-78.) This is a continuation of U. S. patent 2,403,827 (July 9, 1947) and covers a mechanism for regulating the consistency of paper stock.

2,444,685. Multiple fabrication method and apparatus for liquid-tight envelope bags. Harry F. Waters, New York, N. Y. Filed May 6, 1942. 5 claims. (Cl. 93-18.) A method for forming flat-folded envelopes.

2,444,709. Display package. Ersel C. Mulnix, Lake Bluff, Ill. Filed Dec. 7, 1945. 3 claims. (Cl. 229-34.)

2,444,730. Solvent fractionation of tall oil. Lowell O. Cummings and Henry A. Vogel, assignors to Pittsburgh Plate Glass Company, Pittsburgh, Pa. Filed Feb. 21, 1946. 6 claims. (Cl. 260-97.5.) Esterified tall oil is fractionated by means of a nitrohydrocarbon containing one to four carbon atoms and a liquid paraffin hydrocarbon.

2,444,762. Bag and process of making the same. Harry F. Waters, New York, N. Y. Filed July 10, 1944. 5 claims. (Cl. 93-35.) A method for forming a bag having a bottom of the automatically opening type.

2,444,823. Recovery of pentoses and hexosans from wood liquors. Horace E. Hall and Lester L. Coleman, assignors to Masonite Corporation, Laurel, Miss. Filed March 31, 1944. 6 claims. (Cl. 195-11.) The pentosans are fermented by *Aspergillus niger* and the hexosans are precipitated by adding a water-miscible solvent (acetone, alcohols, or ethers).

2,444,830. Adhesive sheet and method of making. Waldo Kellgren, Hubert J. Tierney, and Richard G. Drew, assignors to Minnesota Mining & Manufacturing Company, St. Paul, Minn. Filed April 4, 1938. 20 claims. (Cl. 154-136.) The adhesive sheet consists of a lamination of a flexible film or nonfibrous sheet backing and a thin flexible rope paper reinforcing sheet which is coated on both sides with a pressure-sensitive adhesive. A primer composition for the paper is given.

2,444,861. Frozen-food container. Carleton R. Symmes, assignor to H. P. Hood & Sons, Inc., Charlestown, Mass. Filed Nov. 9, 1945. 3 claims. (Cl. 229-14.) A container for ice cream and other frozen foods.

2,444,878. Gumming machine. Walton C. Marsh, assignor to Marsh Stencil Machine Company, Belleville, Ill. Filed Oct. 30, 1944. 24 claims. (Cl. 91-51.)

2,444,891. Bag. John Johnsson, assignor to Billeruds Aktiebolag, Saffle, Sweden. Filed March 20, 1946. 1 claim. (Cl. 229-62.5.) A filling tube attached to the filling valve of a multi-ply bag has a stiffening insert attached to the top wall.

2,444,895. Sealed box. William A. Ringler, assignor to The Gardner-Richardson Company, Middletown, Ohio. Filed June 2, 1944. 10 claims. (Cl. 229-39.) The patent covers a knock-down one-piece carton capable of being sealed at once or both ends by a cast body of initially liquid sealing substance.

July 13, 1948

2,444,918. Method of making laminated structures. Charles N. Cone, assignor to M and M Woodworking Company, Portland, Ore. Filed March 14, 1941. 3 claims (Cl. 154-132.) A sheet of paper is applied to the surface of wood veneer which has been coated with hot asphalt.

2,444,929. Method of treating bark. Raymond S. Hatch, assignor to Weyerhaeuser Timber Company, Longview, Wash. Filed Jan. 7, 1946. 3 claims. (Cl. 241-14.) A method is described for producing cork from Douglas fir bark by milling and screening.

2,445,034. Sealed slide container. George A. Moore, assignor to National Biscuit Company, New York, N. Y. Filed Dec. 27, 1943. 6 claims. (Cl. 229-9.) The patent covers a food container adapted to be filled through one side.

2,445,080. Web roll support. Charles H. Petskeyes, assignor to Gellman Manufacturing Company, Rock Island, Ill. Filed June 9, 1945. 1 claim. (Cl. 242-68.) This covers a mounting core for a roll of paper.

2,445,112. Method for forming SO_2 by burning sulphur. Worthington T. Grace and Joseph C. Muller, Jr., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del. Filed Dec. 28, 1940. 9 claims. (Cl. 23-179.) This covers a sulphur burner.

2,445,135. Doctor holder. John R. Curtis, Jr., assignor to Scott Paper Company, Chester, Pa. Filed Dec. 18, 1944. 4 claims. (Cl. 92-74.) In the creping of paper on a Yankee machine, a holder is provided for the doctor blade which will afford substantial uniformity of pressure between the edge of the blade and the surface with which the blade coacts.

2,445,174. Web cutter. Burton A. Hannewald and Harold D. Reimer, assignors to Bemis Bro. Bag Company, St. Louis, Mo. Filed May 8, 1946. 21 claims. (Cl. 164-66.) A rotary web cutter.

2,445,254. Machine for the manufacture of wet paperboard. Joseph Winterburn, Bury, England. Filed Oct. 18, 1945. 4 claims. (Cl. 92-67.) The invention relates to an automatic means for severing the roll of paperboard on a cylinder machine; the actuating means is compressed air.

2,445,271. Static eliminating means. William C. Huebner, New York, N. Y. Filed March 17, 1945. 1 claim. (Cl. 175–264.) A static eliminating roller or cylinder is arranged to have rolling contact with the statically charged material.

2,445,290. Hollow cavitied bodies, such as rigid hollow panel structures and method of making the same. Desiré Gonda, assignor to Holoplast, Limited, New Hythe, England. Filed Feb. 23, 1945. 10 claims. (Cl. 154-110.) The basis of the material is resin-impregnated paper.

CLARENCE J. WEST, Chairman, Committee on Bibliography, TAPPI.

July 20, 1948

2,445,412. Box fastening means. William Trogman, Chicago, Ill. Filed Oct. 14, 1944. 1 claim. (Cl. 229-47.) In a merchandising box two box sections are arranged in interfitting latched relation with respect to each other; it is provided with a handle.

2,445,416. Control system for paper machine drives. Rest R. Baker and Walter R. Harris, assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa. Filed Feb. 22, 1945. 6 claims. (Cl. 92-44.) The drive of the auxiliary couch roll is so controlled as to reduce and prevent the occurrence of slippage between it and the traveling web carrier.

2,445,467. Shipping container. Aaron Berke, assignor to Victory Container Corporation, New York, N. Y. Filed Oct. 23, 1947. 7 claims. (Cl. 229-41.) A collapsible shipping container, when unfolded for erection, forms a unitary flapless bottom wall provided with added strength and reinforcement for its corners.

2,445,553 Pressure-sensitive adhesive sheet. Ellington M. Beavers, assignor to The Resinous Products & Chemical Company, Philadelphia, Pa. Filed Nov. 30, 1945. 3 claims. (Cl. 117-122.) The backing material may vary from flexible impervious metal foils to thin porous sheets of paper. The adhesive is a synthetic resin.

2,445,586. Moisture-sensitive paper and the manufacture thereof. Francis L. Simons, assignor to George La Monte & Son, Nutley, N. J. Filed Jan. 14, 1943. 17 claims. (Cl. 117-1.) A safety paper contains a dyestuff that has been substantially decolorized by an alkaline earth hydroxide.

2,445,703. Web associating mechanism. Russell J. Williams, assignor to Bemis Bro. Bag Company, St. Louis, Mo. Filed May 3, 1944. 8 claims. (Cl. 270-52.) This is an improvement of U. S. patent 1,634,067 (June 28, 1927) and relates to a means for forming multi-ply paper tubes.

July 27, 1948

2,445,757. Method of closing bag tube ends. Daniel Belcher, assignor to Bemis Bro. Bag Co., Minneapolis, Minn. Filed June 6, 1946. 7 claims. (Cl. 93-35.) This is a division of U. S. patent 2,406,791 (Sept. 3, 1946); it provides for closing a bag with a single strip of tape.

2,445,831. Window cutting means for envelope machines. Louis Hoffman and August Dalman, assignors to P. L. Andrews Corporation, Brooklyn, N. Y. Filed Feb. 20, 1945. 4 claims. (Cl. 164-28.)

2,445,838. Treatment of waste sulfite liquor. Karl H. A. Melander, Göte E. Sävö, and Tege I. Johanson, assignors to Sulfit Aktiebolaget Gota, Gota, Sweden. Filed Dec. 18, 1944. 6 claims. (Cl. 260-124.) A method is described for transforming the calcium into the sodium salt of lignosulphonic acid.

2,445,945. Wrapping sheet for oil-slushed metal articles. Marshall W. Forrest, assignor to Angier Corporation, Framingham, Mass. Filed May 12, 1943. 4 claims. (Cl. 154-50.) The product consists of an inner layer of creped kraft paper impregnated with an oil-plasticized resin, a central layer of cellulose acetate and an exterior kraft sheet; the whole assembly can be creped.

2,446,001. Bag. Richard D. Elwell, assignor to Equitable Paper Bag Co., Inc., Long Island City, N. Y. Filed Aug. 21, 1947. 1 claim. (Cl 229-56.) A bag construction is described which eliminates the necessity of pins in attaching sales tickets to the bag.

2,446,038. Molding of boxes from laminations of felted fibrous materials impregnated with synthetic resins. Alfonso Amigo, assignor of one-half to Ebonestos Industries Limited, London, England. Filed Nov. 29, 1943. 2 claims. (Cl. 154-1.)

2,446,084. Knockdown carrier carton. John O. Grady, Arab, Ala. Filed Sept. 15, 1943. 6 claims. (Cl. 224-48.) The carton consists of six individual members which, when assembled, forms a portable receptacle.

2,446,161. Bottle carrier. Charles S. Price, Hollis, N. Y. Filed Jan. 19, 1946. 7 claims. (Cl. 229-52.)

August 3, 1948

2,446,264. Molded pulp carton. John W. Cox, assignor to Shellmar Products Corporation, Chicago, Ill. Filed Sept. 20, 1943. 9 claims. (Cl. 229-28.) A molded pulp egg carton has an inner or single row cover and an outer or double row cover.

2,446,308. Package, Louis B. Smith, Chicago, Ill. Filed May 25, 1942. 4 claims. (Cl. 229-14.) A fluid-tight package consists of an inner container supported by a rigid outer carton and is provided with a pouring spout.

2,446,361. Moisture vapor indicator for packaged goods. Herbert B. Clibbon, Detroit, Mich. Filed July 9, 1945. 5 claims. (Cl. 312-31.1.) A method is described for the attachment of a moisture absorbent and indicator to a package.

2,446,366. Display box. Thomas B. Epps, Boston, Mass. Filed May 29, 1944. 1 claim. (Cl. 206-45.11.) A rectangular box consists of upper and lower sections hingedly connected.

2,446,413. Apparatus for bending hard grainless fiber sheets. Per H. Esbjornson, assignor to The Coolerator Company, Duluth, Minn. Filed Dec. 2, 1942. 14 claims. (Cl. 18-19.) An apparatus is described by means of which a hard board (such as Masonite) can be heated without damage and bent on relatively short radii.

2,446,418. Electrolytic apparatus for using bagasse to make paper pulp. Hary L. Horn, New York, N. Y. Filed July 13, 1944. 2 claims. (Cl. 204-213.) This is an improvement on U. S. patent 1,779,971 (Oct. 28, 1930) and provides for passage of an electric current through the contents of the digester.

2,446,422. Container. Paul J. Jensen, assignor to Niemand Bros. Inc., Long Island City, N. Y. Filed April 2, 1946. 1 claim. (Cl. 229-5.5.) In a tubular container the cap is adhesively secured at spaced intervals to the neck of the container; the container is adapted to the packaging of photographic films.

2,446,513. Pulpstone joint material. Yngve H. Nordstrom, assignor to Norton Company, Worcester, Mass. Filed Sept. 20, 1947. 4 claims. (Cl. 51-206.4.) The filler consists of a sandwich having outer layers of butadiene-acrylic nitrile copolymer and an inner layer of vulcanized natural rubber.

August 10, 1948

2,446,551. Separation of pure bark fiber from finely comminuted bark. Robert D. Pauley, assignor to Weyerhaeuser Timber Company, Longview, Wash. Filed Oct. 19, 1945. 7 claims. (Cl. 209-235.) Substantially pure bark fibers are obtained by crushing and dry screening the bark substance.

2,446,594. Machine for pressing grooves in pasteboard sheets. Arthus K. A. Johansson, Goteborg, Sweden. Filed Feb. 8, 1945. 1 claim. (Cl. 93-58.1.) A series of rollers is used to form grooves in pasteboard sheets deep enough for the easy bending of the sheet to form a box.

2,446,644. Method and apparatus for compacting fibrous material. Albert C. Fischer, Chicago, Ill. Filed Oct. 6, 1941. 8 claims. (Cl. 154-1.) This is a continuation of U. S. patent 2, 257,738 (Oct. 7, 1941) and provides for the compacting of fibrous material (such as straw) and securing the product by stitching or by the use of adhesives.

2,446,649. Automatic machine for making beaded cups. Whitney J. Gregory, Peoria, Ill. Filed March 26, 1947. 10 claims. (Cl. 93-47.) The machine consists of a blanking and forming die and a plurality of beading units.

2,446,690. Self-locking paper roll chuck. Albert J. Carpenter, Jr., assignor to Goss Printing Press Company, Chicago, Ill. Filed March 15, 1944. 12 claims. (Cl. 242-68.) A chuck is described which can be used for plain sulphite cores or cores which have metallic ends.

2,446,798. Container forming machine. John G. Vergobbi, assignor to Pneumatic Scale Corporation, Limited, Quincy, Mass. Filed Sept. 30, 1943. 5 claims. (Cl. 93-59.) The machine has provision for shaping a flat bag into rectangular form to provide a bag suitable for use as an individual container or as the inner bag or liner for a carton.

2,446,914. Pallet construction. Clifford D. Fallert and John W. Meinhardt, assignors to Gaylor Container Corporation, St. Louis, Mo. Filed Sept. 30, 1944. 6 claims. (Cl. 248-120.) The pallet is formed of corrugated paperboard or other paper stock.

August 17, 1948

2,447,014. Manufacture of essence containing packages for brewing beverages. Hans O. Irmscher, assignor to National Urn Bag Co., Inc., Long Island City, N. Y. Filed Nov. 25, 1940. 2 claims. (Cl. 93-3.) A machine for the manufacture of tea bags and the like is described.

2,447,161. Apparatus for the manufacture of paper and other felted fibrous products. James T. Coghill, assignor to Consolidated Machine Tool Corporation, Rochester, N. Y. Filed June 28, 1943. 4 claims. (Cl. 92-38.)

2,447,235. Machine for making containers from pulpy fibrous material. Harvey R. Denton, assignor to Moist-R-Proof Container Co., San Francisco, Calif. Filed Feb. 20, 1945. 13 claims. (Cl. 92-60.) A molding device for the manufacture of containers.

2,447,243. Double-walled foldable carton. William G. Freel and Samuel F. Jones, assignors to William P. Frankenstein, Cincinnati, Ohio. Filed Jan. 21, 1941. 3 claims. (Cl. 229-34.) A carton formed of double walls may or may not have an air space between the walls.

2,447,285. Pallet. Budd E. Simonton and Howard J. Dyer, assignors to St. Regis Paper Company, New York, N. Y.

(continued on page 40)

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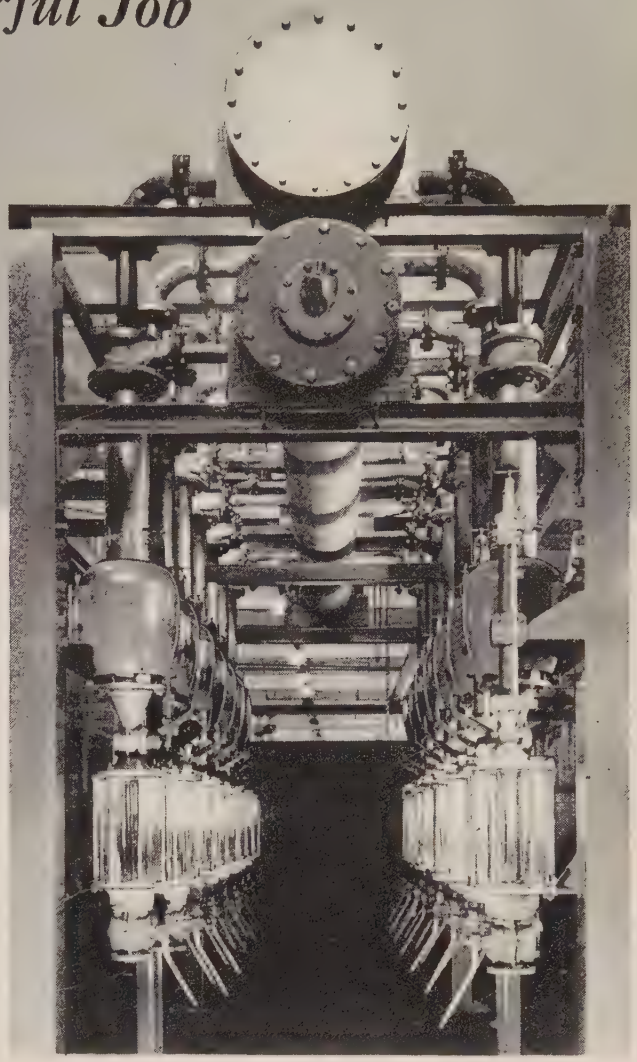

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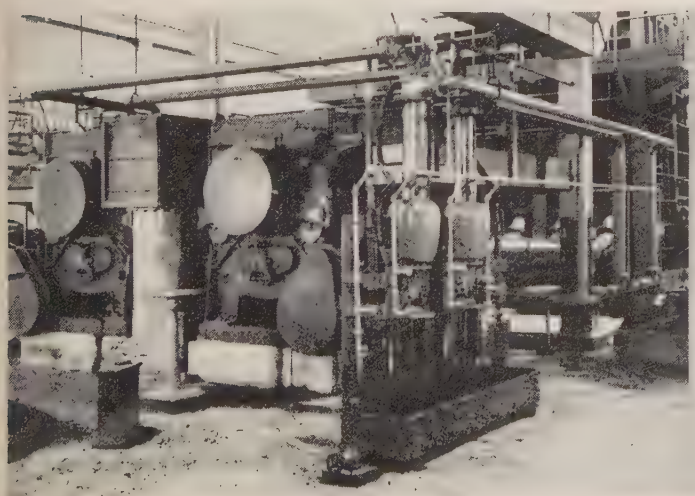

IDEAL FOR SCREEN TAILINGS

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(continued from page 38)

Filed Oct. 8, 1946. 1 claim. (Cl. 248-120.) A two-faced pallet is formed of corrugated paperboard.

2,447,374. Method of applying coating materials. James S. Smyser, assignor to Behr-Manning Corporation, Troy, N. Y. Filed Oct. 25, 1939. 2 claims. (Cl. 117-93.) This is a continuation of U. S. patent 2,287,837 (June 30, 1942) and relates to the preparation of a suede-like surface on paper or other backing material.

August 24, 1948

2,447,514. Method of dissolving cellulose in ammoniacal copper compounds. Theodor Lieser, assignor to American Bember Corporation, New York, N. Y. Filed Dec. 12, 1940. 4 claims. (Cl. 106-167.) A method is described for dissolving cotton linters, wood pulp, and the like in a solution of a copper salt in 5% ammonium hydroxide, the solution finally being cooled to −8°C.

2,447,532. Treatment of pigment comprising calcium carbonate. Harold R. Rafton, assignor to Raffold Process Corporation, Andover, Mass. Filed Dec. 27, 1946. 10 claims. (Cl. 23-66.) The properties of adhesive requirement, oil absorption, gloss-imparting quality, and/or spreading quality of calcium carbonate (especially that prepared by causticizing sodium carbonate with slaked dolomitic lime) are improved by directing an aqueous slurry of the pigment into the path of travel of a percussive member of a rotor element.

2,447,542. Material handling pallet. Edgar C. Stewart, Arlington, Va. Filed Aug. 13, 1947. 4 claims. (Cl. 248-120.)

2,447,563. Collapsible covered container or box. Kenneth T. Buttery, assignor to Sutherland Paper Company, Kalamazoo, Mich. Filed April 11, 1947. 7 claims. (Cl. 229-36.) The patent covers a container for merchandising foods of various kinds.

2,447,677. Heavy-duty shipping carton. Benjamin M. Williams, assignor to Gaylord Container Corporation, St. Louis, Mo. Filed June 16, 1947. 2 claims. (Cl. 229-14.)

2,447,754. Manufacture and filling of essence containing packages for brewing beverages. Louis Hirschhorn, assignor to National Urn Bag Co., Inc., Long Island City, N. Y. Filed June 24, 1940. 2 claims. (Cl. 93-3.) A machine for forming tea bags and the like is claimed.

2,447,784. Apparatus for creping paper. Arthur H. Wood, assignor to Simplex Paper Corporation, Adrian, Mich. Filed June 4, 1945. 6 claims. (Cl. 154-30.) A method and apparatus are described for creping paper transversely of the predominant fiber length or in both directions.

2,447,914. Process for making alkali cellulose. Andreas Ruperti, assignor to Ciba Limited, Basel, Switzerland. Filed June 20, 1944. 8 claims. (Cl. 260-233.) Sulphite pulp in rolls is passed through a bath containing 50% sodium hydroxide at 80°C. The temperature may vary from 60 to 90°C., the time of passage from 0.5 to 20 seconds, and the concentration of the alkali from 20 to 50%.

2,447,943. Pulpstone. George N. Jeppson, assignor to Norton Company, Worcester, Mass. Filed Oct. 30, 1945. 7 claims. (Cl. 51-206.) The portions of the pulpstone are held by bolts under compression.

2,447,964. Cord handled bag. Richard O. Slindee, assignor to Lydia Duebener, St. Paul, Minn. Filed March 23, 1946. 1 claim. (Cl. 229-54.) A method is described for attaching a cord handle to a paper bag.

2,447,997. Apparatus for sealing containers. Thomas F. Cass, Jr., Douglas Kirk, and Francis W. Lanigan, assignors to Container Corporation of America, Chicago, Ill. Filed April 23, 1943. 7 claims. (Cl. 93-6.) The machine is adapted for closing and top sealing of filled cartons having integral top flaps coated with a thermoplastic composition.

August 31, 1948

2,448,049. Machine for impacting pigments against a rotating disk element. Harold R. Rafton, assignor to Rafton Engineering Corporation, Andover, Mass. Filed March 16, 1943. 3 claims. (Cl. 241-186.) The apparatus consists of a disk rotatable in one direction and means for rotating the disk at a high peripheral speed. It is used for treating pigments to improve their properties.

2,448,198. Machine for making containers. Charles B. Tennent, Sr., assignor to National Folding Box Company, Incorporated, New Haven, Conn. Filed Aug. 26, 1943. 12 claims. (Cl. 93-49.) The patent covers an automatic machine for the high-speed production of so-called "click-top" containers.

2,448,357. Panel facing. Kenneth A. Craig and Richard J. Auchter, assignors to Paper Patents Company, Neenah, Wis. Filed Nov. 29, 1945. 4 claims. (Cl. 154-138.) A resin-impregnated paper (phenol-formaldehyde resin) should contain 30% of the resin and weigh 65 pounds per 3000 sq. ft. It is used as a surface for a plywood panel.

2,448,401. Carton having integrally formed cushioning means. Edward Stone, San Francisco, Calif. Filed Oct. 20, 1944. 2 claims. (Cl. 229-39.) A carton for packaging radio tubes and other fragile articles is provided with a resilient support for the contents.

2,448,487. Paper roll heading machine. Robert White, assignor to Williams & Wilson Limited, Montreal, Canada. Filed Dec. 7, 1945. 5 claims. (Cl. 93-1.) A machine is described for applying adhesive disks of paper or the like to the ends of a wrapped roll of newsprint or other paper.

September 7, 1948

2,448,621. Composition containing tall oil resins. William J. Rice, Brooklyn, N. Y. Filed April 10, 1945. 9 claims. (Cl. 106-123.) This is a continuation of U. S. patent 2,373,709 (April 17, 1945) and relates to coating compositions, paints, or enamels containing tall oil.

2,448,638. Heat-sealing adhesive tape. Thomas F. Murray, Jr., and George F. Sharrard, assignors to Eastman Kodak Company, Rochester, N. Y. Filed Oct. 1, 1943. 4 claims. (Cl. 117-122.) The heat-sealing adhesive consists of a mixture of a condensation product of one mole of melamine and three moles of formaldehyde and a partially hydrolyzed polyvinyl acetate.

2,448,679. Knockdown tray stack. John W. Meinhardt, assignor to Gaylord Container Corporation, St. Louis, Mo. Filed July 14, 1944. 2 claims. (Cl. 229-41.)

2,448,689. Debarking apparatus. Auxilius P. Schnyder, Teaneck, N. J. Filed Oct. 16, 1944. 4 claims. (Cl. 144-208.) A rotary drum is provided with debarking instruments and log guide means at one end of the drum. The log guide includes upper and lower guide rolls biased toward a central axis.

2,448,749. Treated planographic printing plate. Charles H. Van Dusen, Jr., assignor to Addressograph-Multigraph Corporation, Wilmington, Del. Filed Jan. 24, 1947. 4 claims. (Cl. 101-149.2.) A paper planographic printing plate is impregnated with 2-amino-1,3-propanediol.

2,448,795. Divisible carton. Louis P. Grecco, Portland, Ore. Filed May 24, 1946. 1 claim. (Cl. 229-28.) A divisible carton for bottles has two duplicate compartmented fillers, the fillers comprising back-to-back transverse partitions with glue flaps attached to the sides of the box.

2,448,819. Pocket-type tissue container. William A. J. Mitchell, Appleton, Wis. Filed Dec. 20, 1944. 2 claims. (Cl. 206-57.) The patent covers a small envelope-like type of dispensing packet for use in coin-controlled vending machines.

2,448,892. Oxidation of cellulose. William O. Kenyon and Edward C. Yackel, assignors to Eastman Kodak Company, Rochester, N. Y. Filed Jan. 1, 1945. 3 claims. (Cl. 8-116.) Airdry fibrous cellulose is immersed in a solution of nitrogen dioxide in carbon tetrachloride for 1 to 16 hours. The degree of oxidation may vary from 1 to 25% of carboxyl groups and the oxidized product may contain from 0.1 to 0.5% nitrogen.

September 14, 1948

2,449,046. Dispensing container. Wilbur L. Barnes and James J. Harrison, assignors to Michigan Carton Company, Battle Creek, Mich. Filed May 9, 1946. 6 claims. (Cl. 229-17.)

2,449,209. Method for improving chemical reactivity and adsorptive capacity of lignin from wood saccharification. Eduard Farber and Mathew Sciascia, assignors to Timber Engineering Company, Washington, D. C. Filed June 12, 1947. 3 claims. (Cl. 260-124.) Lignin is digested with a 1 to 12% solution of an alkali hydroxide at a temperature between 20 and 100°C.

2,449,222. Baby chick shipping box. Russell R. Harness, Elwood, Ind. Filed March 22, 1946. 3 claims. (Cl. 229-15.) In a container having several compartments, means are provided for accessibility to each compartment.

2,449,230. Liquid printing ink containing a lignin compound. Clarence E. Irion, assignor to Margot Corporation, New York, N. Y. Filed July 25, 1945. 18 claims. (Cl. 106-30.) A binder, such as soda lignin, and a coloring matter are dispersed in a hydrophilic liquid carrier containing water. The lignin can be fused with a thermoplastic resin.

2,449,398. Adjustable heads for paper winding reels. Leo Leas, assignor to Lee Paper Company, Vicksburg, Mich. Filed Feb. 13, 1946. 6 claims. (Cl. 242-124.) A winder is described which can be adjusted readily to webs of different widths.

(continued on page 42)

from birch and aspen *now* come semi-chemical pulps

1

Partially cooked birch chips from digester—(actual size).

ABUNDANT and fast growing, these hardwoods are capable of vast increases over standard yields after sodium sulphite treatment followed by SPROUT-WALDRON refining.

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2

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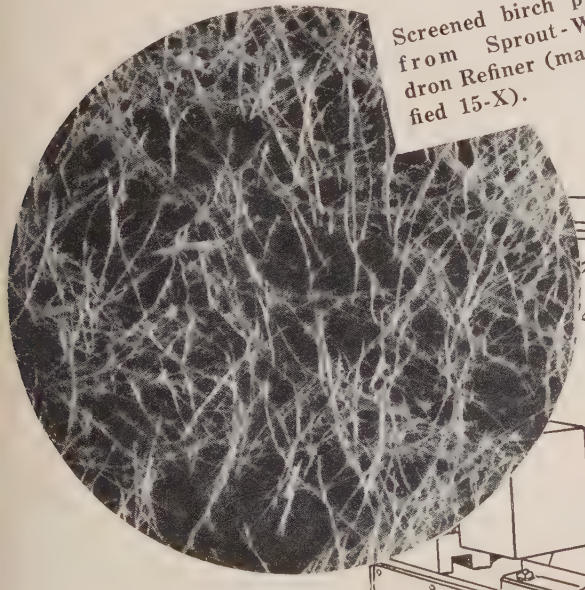

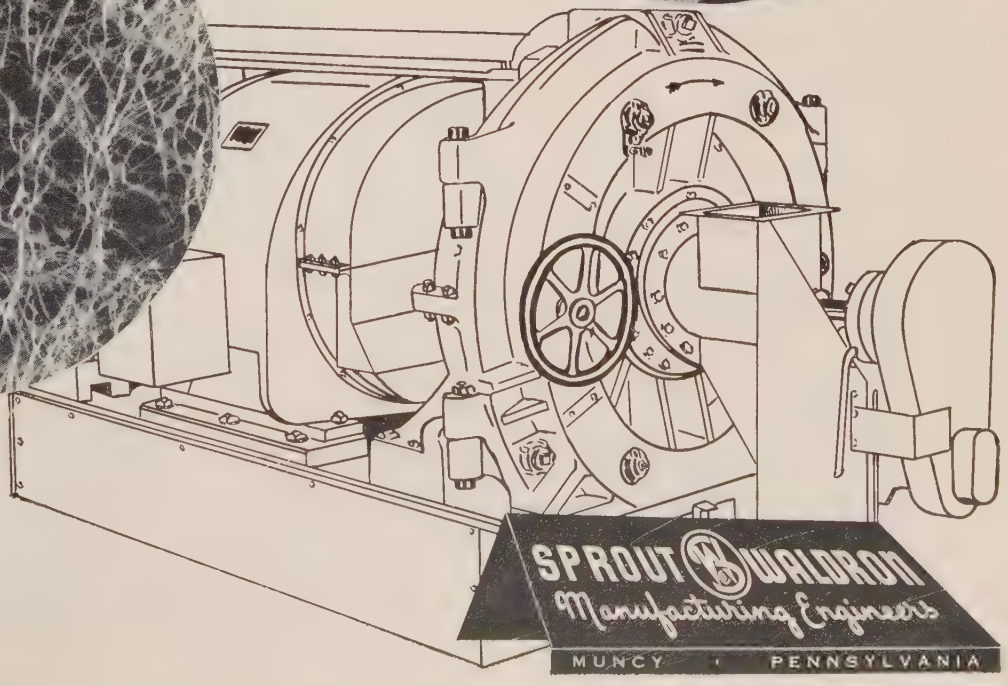

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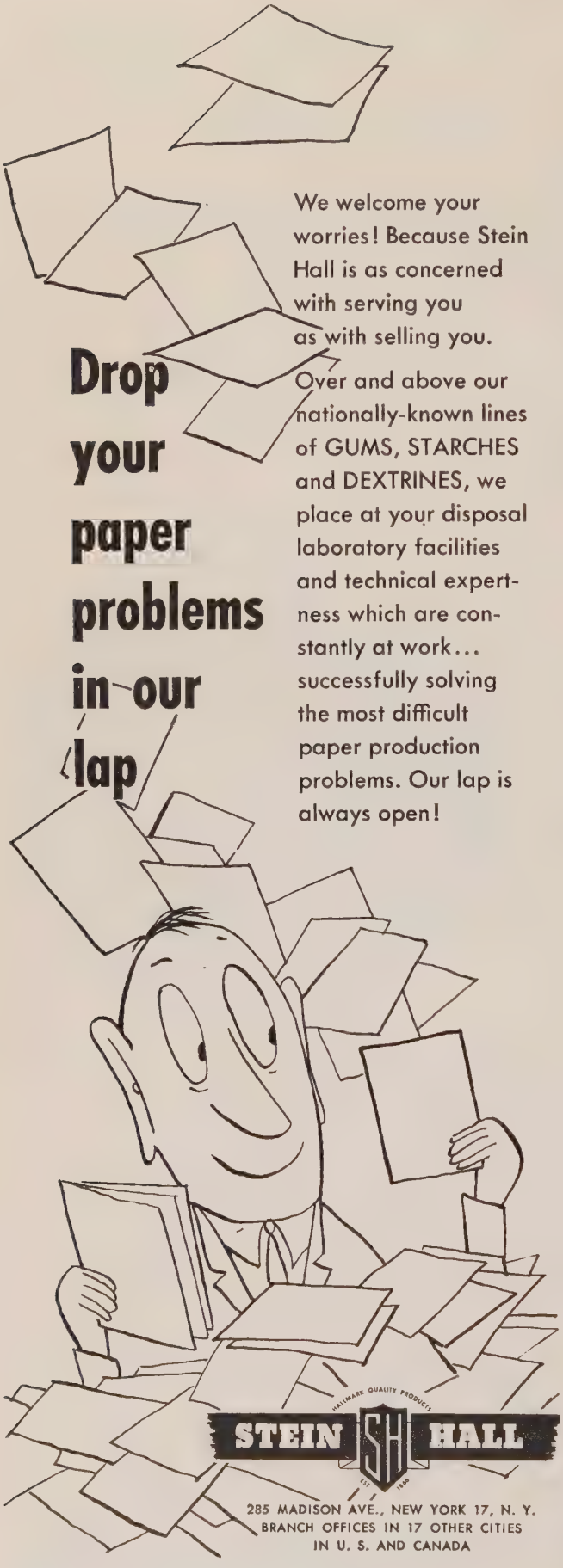
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BRANCH OFFICES IN 17 OTHER CITIES
IN U. S. AND CANADA

(continued from page 40)

September 21, 1948

2,449,537. Recovery of acidic gases. Arthur W. Hixson and Ralph Miller, assignors to The Chemical Foundation, Incorporated, New York, N. Y. Filed July 12, 1946. 12 claims. (Cl. 23-178.) Sulphur dioxide is liberated from an ammonium bisulphite solution by adding solid sodium acid fluoride.

2,449,690. Mechanism for feeding sheets of stiff fibrous material. Fred H. Chapman, assignor to The International Paper Box Machine Company, Nashua, N. H. Filed Aug. 21, 1945. 30 claims. (Cl. 271-26.)

2,449,812. Water-soluble coating composition for paper. Laurence R. B. Hervey and Alvin C. Whitaker, assignors to the United States of America as represented by the Secretary of War. Filed Aug. 27, 1945. 1 claim. (Cl. 260-29.6.) The composition contains (parts by weight) polyvinyl alcohol 75, ethyl alcohol 300, water 300, titanium dioxide 90, and sorbitol lactate 64.

September 28, 1948

2,450,006. Thickener. Frank G. Lesniak, assignor to Masonite Corporation, Laurel, Miss. Filed Aug. 14, 1943. 2 claims. (Cl. 210-149.) An inclined screen for thickening pulp stock in which the stock moves relatively over a relatively horizontal screen area near the upper part of the screen and then with increased speed over a more inclined screen area as it approaches the stock removal means.

2,450,034. Groundwood bleaching by hydrosulfite. Howard J. Cronin, assignor to International Paper Company, New York, N. Y. Filed Dec. 1, 1943. 4 claims. (Cl. 8-104.) Zinc hydrosulphite is added in an amount equal to 1% of the dry weight of pulp; the suspension is mixed with the minimum of agitation and the mixture is allowed to stand for three hours.

2,450,035. Box. Stanley B. De Mian, assignor to International Paper Company, New York, N. Y. A box the inner wall panels of which can be flexed outwardly and upwardly from their normal position in an unfilled box to accommodate contents bulking somewhat greater than the volume of the box normally available for filling.

2,450,083. Treated paper liner for adhesive rolls. Henry V. Donaldson, assignor to The Munising Paper Company, Munising, Mich. Filed Feb. 7, 1944. 2 claims. (Cl. 154-53.5.) A base paper has a coating of adhesive material and a paper cover on the adhesive surface impregnated with a synthetic resin bonding the lint fibers on the surface of the paper to the base whereby the paper cover can be removed from the adhesive surface without adherence of any particles of one material upon the other.

2,450,089. Thermometer package. Valentine Hiergesell and Frank O. V. Hiergesell, Springfield Township, Montgomery County, Pa. Filed Oct. 9, 1947. 1 claim. (Cl. 206-65.) A carton for packaging thermometers and the like.

2,450,110. Consumer type container. Lewis C. Brooks, Milwaukee, Wis., assignor of one-third to Ira Milton Jones. Filed Oct. 2, 1947. 3 claims. (Cl. 229-37.)

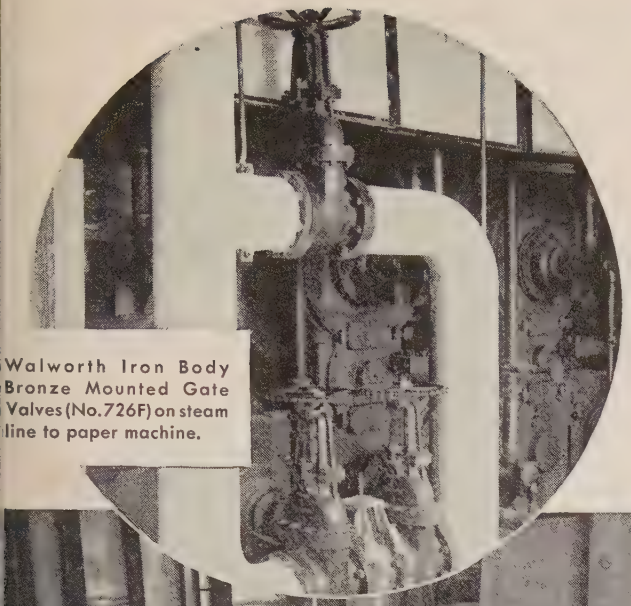
2,450,226. Pulpstone. Hugo W. H. Beth, assignor to Norton Company, Worcester, Mass. Filed May 18, 1946. 2 claims. (Cl. 51-206.4.) A method of constructing a pulpstone eight feet long.

2,450,227. Pulpstone. Hugo W. H. Beth, assignor to Norton Company, Worcester, Mass. Filed May 18, 1946. 5 claims. (Cl. 51-206.4.) This is similar to the above patent.

2,450,244. Beverage container and dispensing device. Clarence S. Lynch, Arlington, Va. Filed Sept. 28, 1945. 1 claim. (Cl. 229-7.) A container with a drinking tube of greater length than the depth of the container.

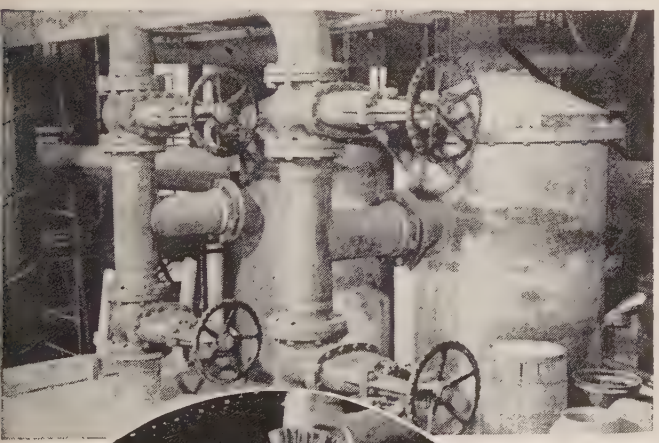
2,450,309. Side gripper for square bottomed paper bag forming machines. Allen O. Sohn, Plymouth, Wis. Filed Jan. 9, 1947. 2 claims. (Cl. 93-8.)

2,450,377. Starch-resin reaction product and method of producing the same. Carl C. Kesler, William C. Black, William L. Hicks, and Carlton N. Owen, assignor to Penick & Ford, Ltd., Incorporated, Cedar Rapids, Iowa. Filed July 31, 1944. 11 claims. (Cl. 260-17.3.) Starch is heated with 5 to 20% of a water-soluble urea-formaldehyde reaction product and sufficient acidic material to lower the pH to about 4 until the proper viscosity is attained.

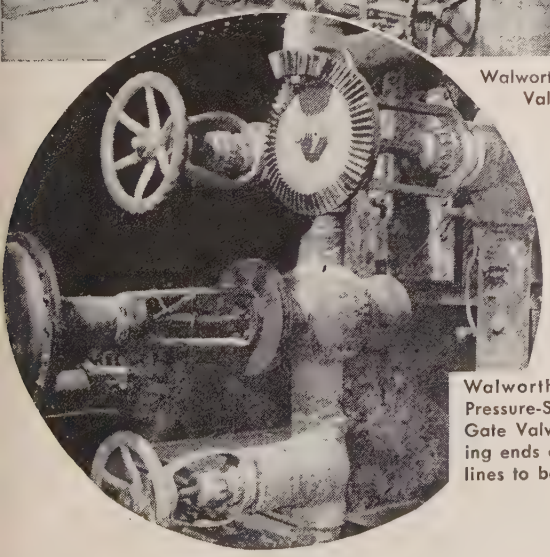


Walworth Iron Body Bronze Mounted Gate Valves (No. 726F) on steam line to paper machine.

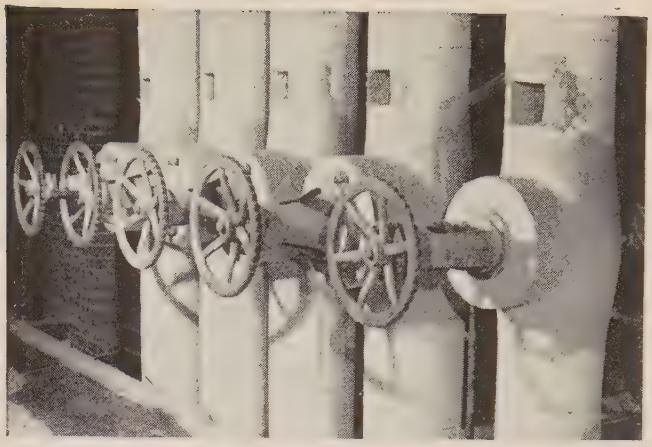
Walworth Special Alloy Pulp Mill Gate Valves (No. 725FS) and Check Valves (No. 928FS) on liquor lines.



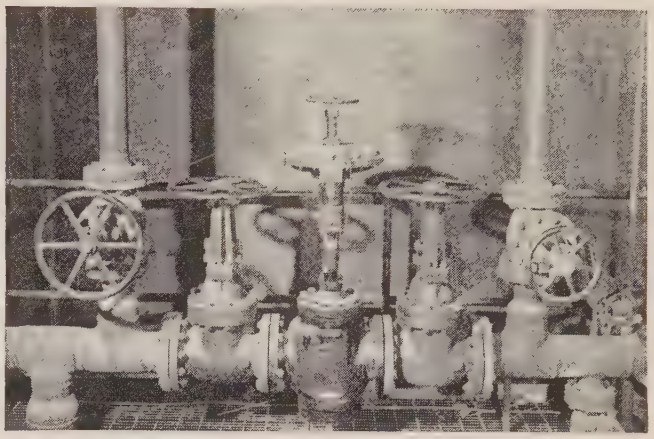
Walworth All Iron Gate Valves (No. 727F) in weak black liquor service.



Walworth Series 900 Pressure-Seal Cast Steel Gate Valves with welding ends on feed water lines to boiler.



Walworth Series 900 Pressure-Seal Cast Steel Gate Valves with welding ends on main steam lines.



Walworth Extra Heavy Steeliron Gate Valves (No. 786F) and Globe Valves (No. 955F) on pressure reducing lines.

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Valves play an important part in the efficient operation of any pulp or paper mill. For new construction, or for maintenance, pulp and paper mill engineers are choosing the right valve for each specific service from Walworth's complete line.

Walworth manufactures valves and pipe fittings of steel, steeliron, iron, bronze, and special alloys. Illustrated are Walworth valves of latest design, installed in a variety of services in a modern pulp and paper mill.

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LOCAL SECTION ACTIVITIES

Reports of Meeting, Personnel and Events

Delaware Valley

During the current year the Delaware Valley Section, which draws its membership largely from New Jersey, Pennsylvania, and Delaware, is meeting on the fourth Thursday of each month.

The membership of the Section has widely divergent interests due to the character of the industry in this region. Most of the mills in this area are much older and smaller than the newer paper mills in other sections, but they have contributed their share to the progress of the industry by concentrating on greatly diversified specialties and converting operations. Since their problems also vary so greatly, it is extremely difficult to find subjects for discussion which will interest more than a small proportion of its membership at any one time. Therefore, representatives of the various groups having similar interests are selected to meet with the Executive Committee of the Section when plans for the Section's activities are being made so that the interests of all will be considered. Two such committee meetings are held in the late summer before the formal opening of the season.

These committees have been so successful in their work that the section outgrew its old traditional meeting place in the dining room of the Engineers Club in Philadelphia, and this year, was moved up to the second floor banquet room of the Club. The loss of our accustomed meeting dates due to this change, has made the adjustment to the less familiar quarters difficult, but we hope to retain the same old feeling of fellowship and continue building up a progressive section.

The general activities of this season started with the visit of a large group of paper mill men to the Chambers Works and the various laboratories of the E. I. du Pont de Nemours & Co. located at Penns Grove, N. J., during the afternoon of September 24. The tour of these laboratories will be especially remembered by those present for the instructive and attractive manner in which the applications of various new products were displayed while having an opportunity of observing fully equipped laboratories at work.

The regular dinner and meeting of the section was held as usual at the Engineers Club in Philadelphia that same evening. We were glad to welcome several representatives from the Lake States Section and also several from mills in Pennsylvania too far from Philadelphia to attend the meeting regularly. More than a hundred were present to hear Dr. Thomas Martone, Jr., of the E. I. du Pont de Nemours & Co. discuss some of the new developments in surface-reactive agents for stock preparation. Dr. Heinz Lips of the same company discussed some of the more recent applications of dyestuffs to paper.

The regular Delaware Valley Section meeting in Philadelphia on October 28 was well attended in spite of the large number of our members attending the national TAPPI Engineering Conference in Buffalo that week. Stream pollution legislation pending in Pennsylvania and in several surrounding states has made waste water problems of vital importance to the mills in this region. Representatives of the National Council on Stream Improvement were invited to discuss suggestions which would assist the mills, and to clarify, if possible, the probable interpretations of these laws applying to paper mill waste water disposal which would be imposed on them.

V. C. Behn, development engineer for the National Council on Stream Improvement, discussed the effectiveness of sedimentation for mill wastes obtained in three pilot plant trials. These trials were made in sulphite-soda pulp mills which also had some de-inking process waste problems.

Dr. H. W. Gehm, technical advisor for the National Council on Stream Improvement, discussed pollution abatement activities in the paper industry throughout the United States and described briefly the four general types of processes being used for the clarification of mill waste waters. As usual for this section, a very lively open discussion followed the presentation of the formal papers.

The November meeting was held on Monday, the 29th, because the regular date fell on the Thanksgiving Day holiday. F. T. Carson of the Paper Section, National Bureau of Standards, discussed the measurement of water resistance of paper. The various types of tests used for the measurement of sizing, or of treatments for increasing the water resistance of paper were described briefly. The importance of selecting the correct type of test for the particular problem under consideration was stressed, since different test methods are not equally applicable over a wide range of paper grades, or for the measurement of different types of water resistance in the same paper. A fuller description of this presentation is not given here since the paper will probably be published in full at a later date. No meetings are being scheduled for December and February because of the holidays and the TAPPI convention in New York.

On January 27, Elmer K. Stilbert, Jr., of the Dow Chemical Co. presented a paper on "Synthetic Rubber Latices as Adhesives for Mineral Pigment Coated Papers."

The programs for the balance of the year are as follows: March 24—Prof. Herman Mark of the Polytechnic Institute of Brooklyn will give a lecture on "Recent Progress in Cellulose Research"; April 28—There will be a panel discussion on Testing Methods, led by R. J. Knoll of the Scott Paper Co.; and on May 26—J. L. Ritchie of the United States Pulp Producers Association will give a talk on "The Long Range Picture of Pulp Supply."

J. P. Weidner, Container Corp. of America, *Chairman*
Miss L. V. Hans, Hercules Powder Co., *Secretary*

Maine-New Hampshire

One of the 1948 national fall meetings of TAPPI was held on September 27–29 at Poland Spring, Me. This meeting, jointly sponsored by TAPPI and the Technical Section, Canadian Pulp and Paper Association, was devoted to mechanical pulping and was originally conceived by Worthen Brawn, late president of TAPPI. Seventeen papers on the subject were presented by qualified speakers from Canada and this country. Arrangements were in charge of the Maine-New Hampshire Section. Attendance was in excess of 250. Publication of the Mechanical Pulping Conference papers began in the January issue of *Tappi* and will continue in subsequent issues. Simultaneously, the papers are being published in the *Pulp and Paper Magazine of Canada.*

The present officers of the Section are: Chairman, John L. Parsons; Vice-Chairman, George Day; Secretary-Treasurer, H. E. Pratt; Executive Committee, Charles I. Horton, A. P. Gregory, J. F. Wright, J. J. Thomas, R. S. French, and L. C. Jenness.

(continued on page 46)

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THE "STOCK-MAKER" IS A FIBER-BEATER

GIVING the maximum brushing, fibrilation, hydration and fiber length retention with minimum power, space and maintenance.

IMPROVING quality and increasing production through its controlled beating and refining action on a continuous flow basis — no batching or cycling required.

EXCELLING on sulphite, kraft, rag and mixed furnishes, making tissues, wrapping, bag, board, book, writing, glassine and other grades. Used either for 100% treatment or to supplement beaters and jordans.

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Standard of the World

(continued from page 44)

New England

The New England Section started its current season at the Red Lion Inn, Stockbridge, Mass. Three papers were presented: (1) "A Positive Solution to the Present Critical Unreliable Rag Papermaking Fiber Situation," by Earl Brennan, Railway Supply & Mfg. Co., Cincinnati, Ohio; (2) "The Present Rag Situation—A Committee Report on Foreign Troublesome Fibers and Finishes in Textile Wastes Used in Rag Paper Manufacture," by K. P. Geohegan, Chairman, Aetna Paper Co., Dayton, Ohio; (3) "The National Program for Stream Improvement as Related to the Mills in the Berkshire Region," by Russell P. Winget, National Council for Stream Improvement.

On November 19 a joint meeting was held with the N.E. District, Am. Soc. for Testing Materials at the Sheraton Hotel, Worcester, Mass. W. R. Willets, Titanium Pigment Corp., and L. R. Reid, Metropolitan Life Insurance Co., both of New York City, presented a paper on "The Philosophy of Specifications" and Prof. George P. Wadsworth at the Mass. Inst. of Technology talked on "Practical Quality Control."

The January 21 meeting at the Roger Smith Hotel in Holyoke, Mass., was devoted to a panel discussion on "Saturation of Paper." Ralph Nazarro, Premoid Products Co., West Springfield, Mass., talked on "The Theory of Saturation." J. J. Uber, Texon, Inc., Huntington, Mass., discussed "Machine Saturants," and Edward Higbee, General Latex and Chemical Co., Cambridge, Mass., talked on "Saturants." The panel moderator was R. H. Mosher, Holyoke Card & Paper Co.

C. H. Child, Merrimac Paper Co., and chairman of the Section has appointed as members of the Publicity Committee to assist *Tappi* Art Dreis, Chairman, Randall H. Doughty, L. B. Tucker, Miss Helen U. Kiely, R. H. Mosher, and F. S. Klein.

Kalamazoo Valley

The first in the current series of meetings of the Kalamazoo Valley Section was held on October 7. A. H. Nadelman, Director of the Papermaking courses at Western Michigan College, gave a report on his plans for conducting the new course in pulp and papermaking.

On November 7, H. K. Kingsbury of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., discussed "Pumps in General and High Density Pumps in Particular." Two color films were shown, one on the new stream-barking of logs and the other on high-density feeders used for pumping stocks of 10% consistency.

At the December 2 meeting John P. Bainbridge of the Monsanto Chemical Co. presented W. S. Wilson's paper on "Sizing Determinations and the Wet-Break Test."

On January 13 the 14th annual "Paper Makers Get-together," sponsored jointly by the Section and the Michigan Div. of the Superintendents Association was held. About 400 were present to hear Cola B. Parker, President of the Kimberly-Clark Corp., talk on "What Price Freedom." William Race, President of the Sutherland Paper Co., presided as toastmaster.

Ohio

The initial meeting of the Ohio Section of TAPPI was held at the Manchester Hotel, Middletown, Ohio, on October 19, 1935. Sixty-eight members and guests were present. The following officers were elected to serve the new organization: Chairman, V. F. Waters, Wrenn Paper Co.; First Vice-Chairman, J. J. O'Connor, Mead Corp.; Second Vice-Chairman, H. H. Latimer, Beckett Paper Co.; and

(continued on page 48)

A RESEARCH CORPORATION COTTRELL

will save you $1000 to $1500 worth of salt cake every day

The engineer from Research Corporation spoke confidently. He had studied the equipment layout, and noted that the mill had a capacity of 1,000 tons of pulp per day. From his experience and specialized knowledge he knew that he could safely anticipate a minimum recovery of 100 pounds of salt cake for each ton of pulp produced—total: 50 tons of salt cake per day—value: $1,000.00 to $1,500.00 per day dependent upon salt cake cost prevailing at the plant.

Performance like this is the result of over 35 years of experience combined with careful engineering appraisal, attention to details and a remarkably efficient method. These, plus equipment which gives recoveries of 90 to 99%, are responsible for outstanding records of recovery.

If you are losing your chemicals through the stack in a soda or sulphate mill investigate the Research Corporation Precipitator.

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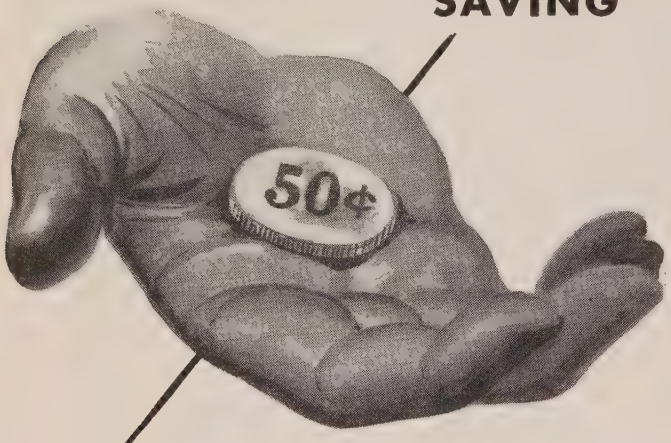

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A TISSUE MILL ran an Orr-Chem treated felt and produced 457 tons at a cost of $1.20 per ton for felting, or a $550.23 total. The untreated felt the Orr-Chem replaced ran only 7 days, at a cost of $1.70 per ton. Total saving $228.50 or 50c per ton. "Neat little saving in any man's mill."

One of the largest board mills, having used several Orr-Chem treated felts, reports a saving of 17c a ton on felt costs.

Other examples — 6 weeks vs. 3 weeks on a suction press; 11 weeks vs. 6 weeks on a super-suction press; cost reduced 22½c per ton on top, bottom and press felts — and so the story goes in mill after mill.

If you haven't checked chemically-treated (ORR-CHEM) felts for drainage, wear and other beneficial characteristics, it's high time that it be done.

ALSO FULL LINE OF
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THE ORR FELT & BLANKET CO., PIQUA, OHIO

ORR-CHEM

(continued from page 46)

Secretary-Treasurer, C. D. Roess, Wrenn Paper Co. G. H. Harvey, Gardner-Richardson Co., was elected to serve on the Executive Committee.

R. G. Macdonald, National TAPPI Secretary, introduced the principal speaker of the evening, C. C. Heritage, President of TAPPI. Subject of Mr. Heritage's talk was "Why Be a TAPPI Man." He pointed out that the Association is essentially a service organization devoted to the finding, organizing and disseminating of technical facts of particular application and usefulness to the pulp and paper industry.

In its 13 years of existence, the Ohio Section has had the following papermakers to serve as its chairmen:

Year	*Chairman*	*Company*
1935–37	V. F. Waters	Wrenn Paper Co.
1938	Homer H. Latimer	Champion Paper & Fibre Co.
1939	K. P. Geohegan	Aetna Paper Co.
1940	John E. Burdsall	Crystal Tissue Co.
1941–42	Harry Fisher	Gardner-Richardson Co.
1942–46	Carl D. Roess	Wrenn Paper Co.
1946–47	Sam Olsen	Champion Paper & Fibre Co.
1947–48	D. M. Yost	Sorg Paper Co.
1948–49	Phil S. Cade	Harding Jones Co.

The program for the current year has adopted the general theme of "Let's Talk About .....," and has developed six meetings on this, the first three of which have been concluded. They are (1) "Let's Talk About Pulp," (2) "Let's Let the Converter Talk About His Paper Problems," and (3) "Let's Talk About Statistical Control." The others will be: "Let's Talk About Our Pet Ideas," "Let's Talk About Calender Stack Finishes," and "Let's Talk About Paper Coating."

Vance P. Edwardes, Sulphite Superintendent of International Paper Co., Palmer, N. Y., gave the first talk of the above series. He covered both mechanical and chemical (acid, neutral, and alkaline) pulping methods.

Mechanical pulping has developed far since it was first patented in 1855. The natural sandstones which were first used have largely been replaced by artificial ones of carborundum and silicon carbide. These stones will operate up to 125 hours before the stone's burr needs reground, whereas natural stone averages only 8 hours. This is important to high production and to quality control as the stone pattern controls fineness of the fibers. Continuous grinding with stones weighing up to 25 tons and operating at 5000 ft. per minute, gives yields of around 94% using from 50–100 hp. per ton.

White spruce makes the best groundwood with highest strength, excellent color, and good yield. Hemlock, balsam, and white pine give lower strength, poorer color, and lower yields.

Both oxidizing (Na_2O_2 or H_2O_2 and hypochlorites) and reducing (H_2SO_3) bleaches are being used to produce bleached groundwood with 10 points increase in brightness.

Groundwood pulp is characterized by low strength, high opacity (97%), fair color (55–65 G.E. brightness), and lack of permanence. Its chief use is in making newsprint, but it is valuable in making hangings, catalogue, tablet, salesbook, tissues, towelling, and some publication papers. The bleached groundwood is used in the higher grades of publication, coated-two-sides (machine coating) and coated-one-side (label).

Soda pulp was patented in England in 1852, but was largely developed in the United States. The deciduous woods of aspen, birch, maple, and cottonwood are the chief source of soda pulp whose yearly production is around 503,000 tons.

The wood chips are cooked in steel digesters with direct steam, for 4–6 hours at 110 pounds pressure using 20% caustic (NaOH) on the weight of the wood. It is blown at full pressure into blow tanks, washed in pans or over

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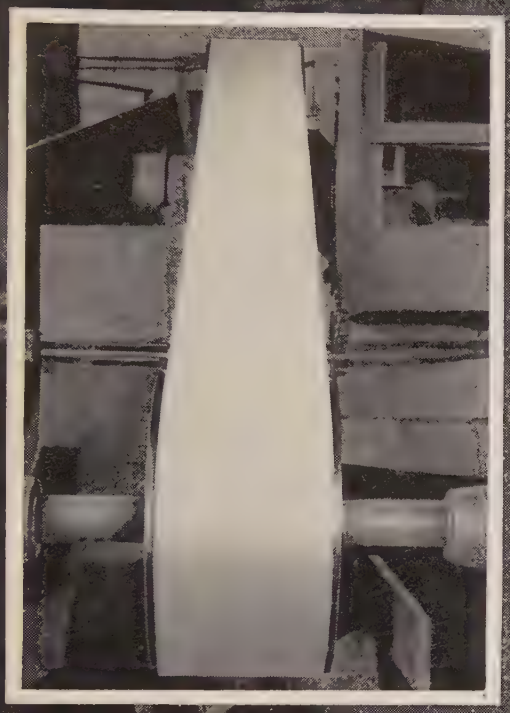
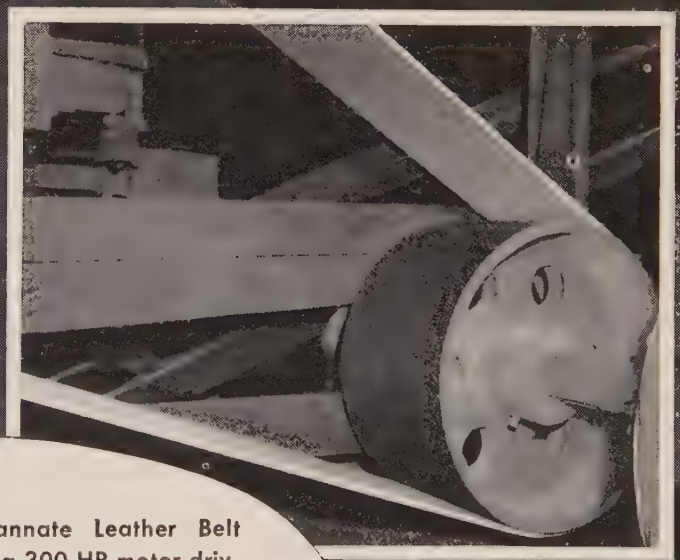
in this well-known
PAPER MILL...





This 20″ four-ply Rhoads Tannate Leather Belt (39 4/12′ Long)—installed on a 300 HP motor driving an 88″ ten knife chipper—runs 5860 feet per minute and has been giving satisfactory service for more than 2 years.

Let us tell you why Tannate is chosen for such service!

HYDRAULIC PACKINGS
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PRODUCERS OF FINE LEATHER FOR 247 YEARS

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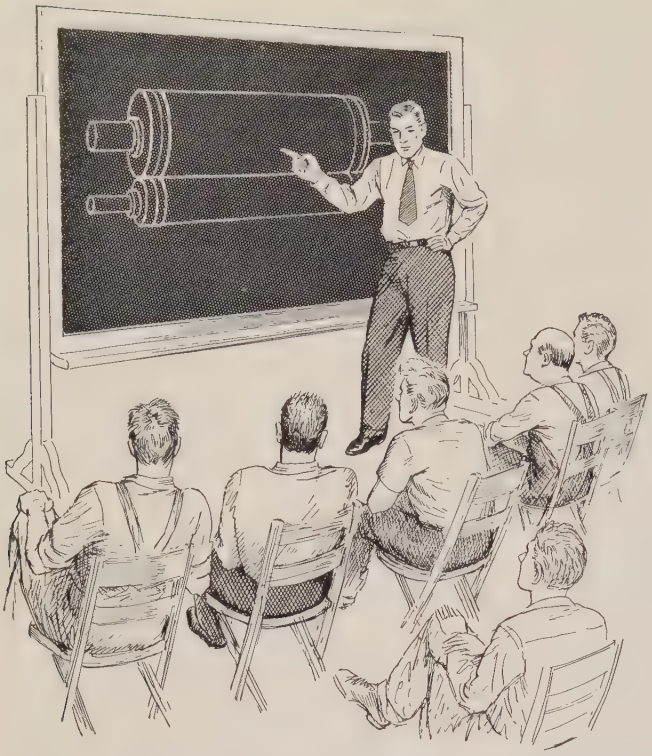

"Yes, we're getting better paper finishes at a lower cost"

"What happens right *here* determines the kind of finish we give our paper. A recent test with new Butterworth Calender Rolls has shown we're able to get better finishes at a lower cost. Our production has been more uniform. Our records show fewer delays and breakdowns. Standardizing on Butterworth Calender Rolls has meant a definite savings to our mill."

Butterworth Calender Rolls are made of the finest materials available, long staple cotton free of any foreign matter and top quality paper of high rag content. Through a special process, Butterworth Rolls are locked on the shaft under tremendous pressure. Can't slip or come loose. Pre-tested for smoothness, hardness and density. Made to your exact specifications.

Let us help with your calendering problems. We make calender rolls for every type of calendering in every size. We can also refill your present rolls.

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Butterworth Calender Rolls

(continued from page 48)

vacuum washers in series for recovery of liquor and its reuse by evaporation and burning.

Bleaching is usually by multiple stage: chlorination, hypochlorite, and sulphur dioxide, resulting in a G.E. brightness of 74–80 and an opacity of 82%. Yields for unbleached pulp are about 44% and bleached 40%.

The pulp is characterized by low strength, short fibers, soft and bulky. Its chief use is in making book, envelopes, and high-grade printings when mixed with long-fibered sulphite and/or kraft.

Sulphate or kraft pulping process was invented in 1883, but didn't begin to develop in the United States until 1911. Its very rapid growth was largely made in the South, using the fast-growing pines, although the hardwoods of gum and birch are used.

The wood chips are cooked in stationary, rotary, or circulating digesters either unlined or Cr-Ni clad, for 2–6 hours at 125 pounds pressure and 170°C., using NaOH and Na_2S as cooking liquor. The digesters are blown at full pressure into diffusers or blow tanks and the cooking liquor recovered by evaporation and burning in B&W Tomlinson furnaces.

Kraft was first marketed as an unbleached pulp, but it is now an important bleached pulp, which requires from 5 to 7 stages to be bleached to a G.E. brightness of 80 and an opacity of 75–80. Yields are around 50% for the unbleached and 44% for the fully bleached pulp. Tall oil is the chief byproduct of the pulping process.

Kraft is characterized by its long fibers and high strength. As a bleached pulp it is finding extensive use in fine papers and replacing sulphites to some extent.

Sulphite pulping was invented in 1867 and was in commercial production seven years later. The principal woods used are the nonresinous conifers, though pines seasoned and low in heart wood content can be used, as well as the hardwoods if bleached. Because of the acid cooking liquor, special materials are needed, e.g., lead, copper, bronze, and Cr-Ni steels.

Ceramic-lined steel digesters, varying in size from 4 to 30 tons of pulp per blow, cook the wood chips from 7 to 15 hours at a pressure of 50 to 90 pounds and 125° to 145°C. Only recently has there been any major attempt to recover the cooking liquors, and that by using magnesium based cooking acid instead of calcium. Principal byproducts recovered from the spent cooking liquor are bindarene, alcohol, and yeast.

Pulp quality is controlled by wood quality and cooking, with spruce making the best all-around pulp: high strength, good color, and high yield. Unbleached brightness varies from 45 when pulping hemlock to 65 for spruce. Opacity averages 80% with yields of 45–50%.

As an unbleached pulp, sulphite is used with groundwood in making news, hangings, and printing, and for making tissues, light-colored wraps, toilet and salesbook. As a bleached pulp it is important in furnishes making book, bond, ledger, high-grade printing, tissues, glassine, greaseproof, and dissolving pulps.

The second meeting was conducted as a panel discussion, with F. L. Zellers of the Chillicothe Paper Co. acting as moderator. The program was arranged by Carl A. Ireton of Specialty Paper Co., with the able assistance of W. F. Polfus of Clopay Corp. and T. M. Chemerys of Miami Valley Coated Paper Co.

PROBLEM NO. 1—SLIME SPOTS—CONVERTER NO. 1: Slime spots give the converter considerable trouble. If the hole is at the edge of the sheet, the paper breaks and considerable broke results. If the paper is being printed, the ink strikes through to the printing cylinder which causes an offset on the back side of the paper. Rolls with as many as 30 to 40 splices due to slime spots have been encountered, although

(continued on page 52)

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1864

1949

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NOT a chemical;

yet it aids in controlling pitch and slime.

NOT a filler;

yet it remains in the sheet as ash.

NOT a pigment;

yet it increases brightness and opacity, raises pigment retention and improves formation.

NOT a flocking agent;

yet it has unusual retention properties because of its diatomaceous structure.

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DIVISION OF GREAT LAKES CARBON CORPORATION

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DICALITE

PAPER-AIDS FOR BETTER PAPER PRODUCTS

(continued from page 50)

this is the exceptional case. Slime holes include those holes and spots caused by fungi, bacteria, and molds, and those caused by stock lumps, which do not dry fully and crush out at the calenders. Light weight papers give us the most trouble. We use papers that have basis weights of from 12 to 60 lb. (24 by 36—500).

Discussion: *Mill No. 1:* Good chlorination of the fresh water is very helpful and reduces slime conditions to a minimum on the paper machines. We use *break point* chlorination and carry about 1.5 p.p.m. residual chlorine, however this residual drops to zero on the paper machines.

Mill No. 2: Good progress has been made by the paper industry during the last ten years. We have found that it is necessary to change the slime-treating chemical after ten days to two weeks. Much can also be done by the machine operators to keep the manufactured slime holes at a minimum. These are the fiber lumps that collect at different places in the head box and break loose. Frequent and thorough cleaning is necessary. Chloramine treatment is used on almost all of our paper machines in addition to the mercurials, chlorophenates, etc. A residual of 0.2 to 0.3 p.p.m. of chorine is maintained on the machines. Too high a residual corrodes the wire and other equipment and sometimes causes excessive foam.

Mill No. 3: Slime trouble occurs also in making glassine papers. The heavy supercalendering that is necessary, magnifies the slime trouble for them. We are still searching for a good chemical for killing slime.

Problem No. 2—Caliper and weight variations across the roll—Converter No. 2: In one particular case we experienced a variation of 32 lb. across a roll of rawstock (59-inch deckle) of 155 lb. (25 by 38—500), that we were trying to coat. This is a variation of 20%, while 5% and under is considerably reasonable.

Discussion: No logical explanation was given for this abnormal condition.

Problem No. 3—Color variation—Converter No. 3: We use mostly 55 to 60 lb. basis weight (24 by 36—500) white, gray, and brown sulphites, and experience considerable color variation. How can this be reduced to a minimum?

Discussion: *Mill No. 2:* We do not use chloramine treatment on the paper machines when running colors.

Converter No. 1: Variation in the color and shade of paper causes the ink shade to vary. Receptivity of the paper is also a contributing factor in varying the ink shade. Complaints are increasing.

Problem No. 4—Splices—Converter No. 1: For our operation we require a splice to hold up under a temperature of 140° to 240°F. Exposed parts of the adhesive tape, poorly torn edges, insufficient ironing cause the paper to pull apart.

Discussion: *Mill No. 4:* For light weight papers a low soluble dextrin paste makes a good splicing material.

Mill No. 2: We have used cellulose acetate tape, starch dextrin paste, and rubber cement. Workmanship is a big factor in making a good splice.

Converter No. 1: Ragged edges on splices cause many of the breaks on the waxing machines. How can one make a splice with a smooth edge?

Mill No. 2: Have you ever used a splice made on the bias?

Problem No. 5—Fuzz—Converter No. 2: Fuzzy rawstock caused uneven distribution of coating color on the coated paper. This is especially noticeable when coating colored paper.

Discussion: *Mill No. 5:* The type of wood used to make the pulp and the mesh of the wire (cylinder board machine) has a factor in making fuzzy paper.

(continued on page 54)

SMOOTHNESS

IN HIGH-GRADE coated paper, too, smoothness is essential. This quality is assured when the paper-coating pigment used is Wyandotte Precipitated Calcium Carbonate.

Wyandotte Precipitated Calcium Carbonate is a highly refined chemical—free from grit and abrasiveness. It is high in opacity and covering power but low in alkalinity. Satisfied users of this quality product like its uniformity and exceptional brightness.

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REG. U. S. PAT. OFF.

(continued from page 52)

Converter No. 1: Build-up of fuzz on the printing plate and under the doctor blade on the ink cylinder causes much trouble. Wool felt fibers on the surface of the paper also cause considerable annoyance.

Mill No. 2: Have you noticed any difference when coating a sheet as to the direction that it goes through the coater? That is, if the fuzzy fibers are laid down in one direction, they would have a tendency to rough up if coated in the opposite direction. Use of reflash steam in the first section of driers may reduce fuzz.

Mill No. 5: If there is much picking at the first press roll, considerable fuzz will be encountered. The right use of either rubber, stone, or brass press rolls will be a big help.

Mill No. 6: Keep the press roll doctored.

PROBLEM No. 6—WILD FORMATION—CONVERTER No. 3: Why and how can it be remedied?

DISCUSSION: *Mill No. 7:* There is a committee of National TAPPI that is working on the problem of how to measure and evaluate sheet formation.

Mill Nos. 1 and 2: Both agreed that the pulp manufacturers have a large influence on how well their pulp will form into a sheet, by the manner in which they treat, cook, and select their wood.

Other problems mentioned but not discussed for lack of time were: moisture variation, buckles and ridges, ragged slitter cuts, sizing, wrinkles, pin holes, damaged in shipment, hair and calender cuts, tear-outs in rolls that were not spliced, and opacity and solidity.

Mr. Ireton concluded his remarks with this statement: Jobber salesmen are not always qualified to present the converter's problems to the paper mills. More and better cooperation between the producer and converter will be beneficial for both.

Those present at the December meeting had the pleasure of hearing a talk on Statistical Methods of Analysis as Applied to the Pulp and Paper Industry, by Dr. T. A. Pascoe, Technical Director, Nekoosa Edwards Paper Co., Port Edwards, Wis., and also chairman of the National TAPPI committee on Statistics.

In the course of his talk Dr. Pascoe stressed the fact that the paper industry is way behind other industries in applying this new mathematical science of Statistical Control to their processes and products.

Quality should be everyone's business, and not delegated to one small department of the paper mill. Present testing methods are inclined to be *subjective* instead of *objective* with the results being too slow to prevent poor quality production.

Statistical methods are being applied to controlling the permanganate number of pulp; basis weight, mullen, tear, etc., of paper; and to sorting of skid paper. The latter has resulted in the saving of thousands of dollars in sorting costs, as total inspection is no longer required.

Publicity Committee Appointed

At the meeting of the Section on December 14, Phil S. Cade, Chairman, appointed the following members of the Section to constitute the Publicity Committee to cooperate with the Association's new magazine *Tappi:* H. A. Smith, Mead Corp., Chairman, C. E. Brandon, Aetna Paper Co., Don Goodman, Sorg Paper Co., and R. D. McCarron, Stein, Hall Co.

HERB SMITH, *Chairman, Publicity Committee*

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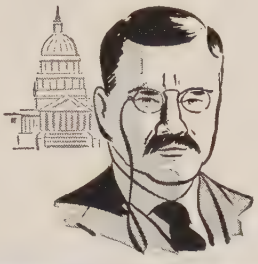
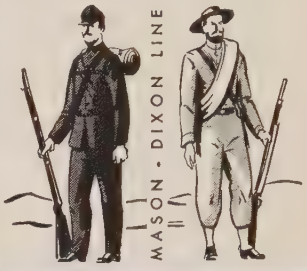
Men work long and well at Lindsay..

Recently two "oldsters" retired from Lindsay employ. One had worked here for 43½ years; the other, for 42½ years. During a ceremony held in their honor at the end of their service, some interesting, if more or less whimsical, figures were concocted, among them the following:

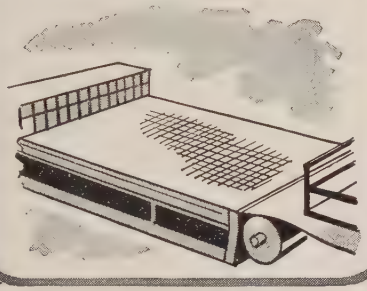
1. They started with us in 1904 and 1905, when Theodore Roosevelt (T.R.) was president of these United States.



2. Together they spent 86 years on the job. That goes all the way back to 1862—to Civil War days and "states' rights".



3. "Sticking to it" for those 86 years, our two men could have woven a total of something like 6500 Fourdrinier wires.



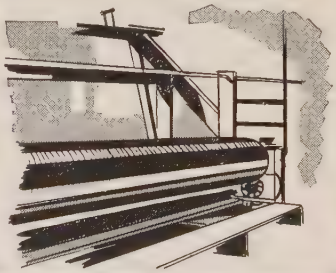
4. Those 6500 wires would keep one paper machine running about 540 years—back to 1408 and days of religious awakenings in Europe.

5. On 6500 wires, 5,000,000 tons of paper could be made, or about 1/4 of all the paper production for the United States in 1947.

6. In 86 years our two men would have walked 172,880 miles while on the job, or about seven times around the world.

7. They would have used approximately 1,300,000 miles of strand wire, which would reach to the moon more than five times.

8. Operating steadily, the bobbins on their looms would have given out and been changed not less than 3,000,000 times.



9. Walking up and down, following the shuttle, our two men would probably have worn out something like 344 pairs of shoes.

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Edgar C. Ahlberg, Factory Manager, Endura Manufacturing Co., Quakertown, Pa., a 1945 graduate of Massachusetts Institute of Technology.

Ross D. Bailey, District Manager, Appleford Paper Products Ltd., Hamilton, Ont., Canada.

Harold N. Baker, Director and General Works Manager, Thames Board Mills Ltd., Purfleet, Essex, England, a 1924 graduate of the University of Toronto.

Hubert L. Beck, Assistant Chief Chemist, Joanna Western Mills Co., Chicago, Ill., a 1928 graduate of Purdue University.

Otto P. Berberich, Research Chemist, International Printing Ink Div., of Interchemical Corp., New York City, a 1940 graduate of Pratt Institute.

Harvey E. Berg, Manager, Pulp and Paper Div., National Aluminate Corp., Chicago, Ill., a 1931 graduate of the University of Illinois.

Alfred D. Bonanno, in charge of Coating Dept., Champion-International Co., Lawrence, Mass., a 1936 graduate of Northeastern University.

Francis H. Bratton, Research Chemist, Hercules Powder Co., Wilmington, Del., a 1937 graduate of Washington College, with a Ph.D. degree from Clark University in 1941.

William B. Burgard, Supervisor, Engineering and Methods Dept., J. W. Clement Co., Buffalo, N. Y., a 1941 graduate of Dartmouth College.

Enrique J. R. Catarineu, Technical Engineer, Papelera San Isidro, San Isidro, Argentina, a 1920 graduate of Escuela Ingenieros Industriales, Barcelona, Spain.

Sachindra C. Chatterjea, Chemist, India Paper Pulp Co. Ltd., Naihati, West Bengal, India, a 1933 graduate of Scottish Church College, with an M.S. degree from Science College, Calcutta, in 1935.

LaVerne E. Cheyney, Research Director, Waterproof-Ohio Paper Co., Middletown, Ohio, a 1933 graduate of the University of Akron, with an M.S. degree from the University of Pennsylvania in 1935, and a Ph.D. degree from Ohio State University in 1938.

Robert E. Collins, Student, Pulp and Paper Dept., New York State College of Forestry, Syracuse, N. Y.

Martin L. Cordell, Packaging Sales and Engineering, Phillips Paper Products, Inc., Brooklyn, N. Y. Attended the College of the City of New York and New York University.

Paul F. Crockett, Supervisor, Newport News Shipbuilding and Dry Dock Co., Newport News, Va., a 1927 graduate of Virginia Polytechnic Institute.

Robert P. Crooks, Junior Process Engineer, Marathon Corp., Menasha, Wis., a 1948 graduate of Purdue University.

Paul E. Daly, Laboratory Technician, Taggart Corp., Oswego, N. Y.

Robson B. Dunwody, Chemical Engineer, The Celotex Corp., Chicago, Ill., a 1934 graduate of Tulane University.

Floyd S. Edmiston, Jr., Engineer Draftsman, Southern Kraft Div., International Paper Co., Springhill, La., a 1947 graduate of Louisiana State University.

Henry D. Fisher, Student, Institute of Paper Chemistry, Appleton, Wis., a 1943 graduate of Oberlin College.

Wilbur P. Foote, Sales Engineer, The Bristol Co., Waterbury, Conn., a 1934 graduate of Massachusetts Institute of Technology.

George W. Garland, Sales Engineer, Dudley, Garland & Jensen, Inc., Cambridge, Mass.

Lloyd E. Goodwin, Chief Chemist, Macon Kraft Co., Macon, Ga., a 1934 graduate of the University of Maine.

Robert P. Green, Student, Pulp and Paper Dept., New York State College of Forestry, Syracuse, N. Y.

James D. Griffin, District Manager, Scutan Div., Union Bag and Paper Corp., Hudson Falls, N. Y., a 1920 graduate of St. Lawrence University.

Loren D. Grubb, Chief Process Engineer, Cit-Con Oil Corp., Lake Charles, La., a 1937 graduate of Kansas State College.

Mohammed A. Hadi, Chemist, The Sirpur Paper Mills Ltd., Sirpur Kaghaznagar, Hyderabad-Deccan, India, a 1942 graduate of Osmania University.

G. Emil Haeger, Student, Pulp and Paper Dept., New State College of Forestry, Syracuse, N. Y., a 1944 graduate of Royal Technical University, Stockholm, Sweden.

Harold F. Hitchcox, Chemical Engineer, Standard Oil Development Co., Elizabeth, N. J., a 1938 graduate of Rensselaer Polytechnic Institute.

Eugene A. Holland, Owner, Eugene A. Holland Industrial Advertising, Philadelphia, Pa.

R. Blakeley Honeyman, Sales Engineer, Morden Machines Co., Portland, Ore.

L. Almeida Huerta, Industrial Engineer, Cellulosa Argentina S. A., Buenos Aires, Argentina, a 1944 graduate of Universidad de Buenos Aires.

Martin B. Hutchinson, Treasurer and General Manager, Brown-Hutchinson Iron Works, Detroit, Mich., a 1929 graduate of the University of Michigan.

Allan Hyer, Vice-President, Bagley & Sewall Co., Watertown, N. Y. Attended the University of Cincinnati.

Floyd E. Israel, Chemical Engineer, Central Fibre Products Co., Inc., Hutchinson, Kan., a 1928 graduate of Kansas State College, with an M.S. degree from North Carolina State College in 1929.

Jean R. V. Istas, Research Chemist, Belgian Ministry of Colonies, Tervuren, Belgium, a 1946 graduate of the University of Louvreins.

William H. Kennedy, Student, New York State College of Forestry, Syracuse, N. Y.

Ralph H. Kenan, Research Engineer, St. Regis Paper Co., Oswego, N. Y., a 1947 graduate of Syracuse University.

Louis T. Kimple, Research Dept., Dixie Wax Paper Co., Dallas, Tex., a 1947 graduate of Southern Methodist University.

Harry C. Kinne, Jr., Superintendent of Pulp Mill, Manistique Pulp and Paper Co., Manistique, Mich., a 1936 graduate of Colgate University.

H. Dean Kitchen, Co-ordinator of Engineering, Grand Rapids Fibre Cord Co., Grand Rapids, Mich., a 1923 graduate of the University of Wisconsin.

Hernan H. Koerwitz, Marathon Corporation, Menominee, Mich., a 1933 graduate of the University of Wisconsin.

William A. Kosicki, Sales Engineer, Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

Hugh H. Lavery, Assistant Chemist, International Paper Co., Hudson River Mill, Palmer, N. Y., a 1947 graduate of Massachusetts Institute of Technology.

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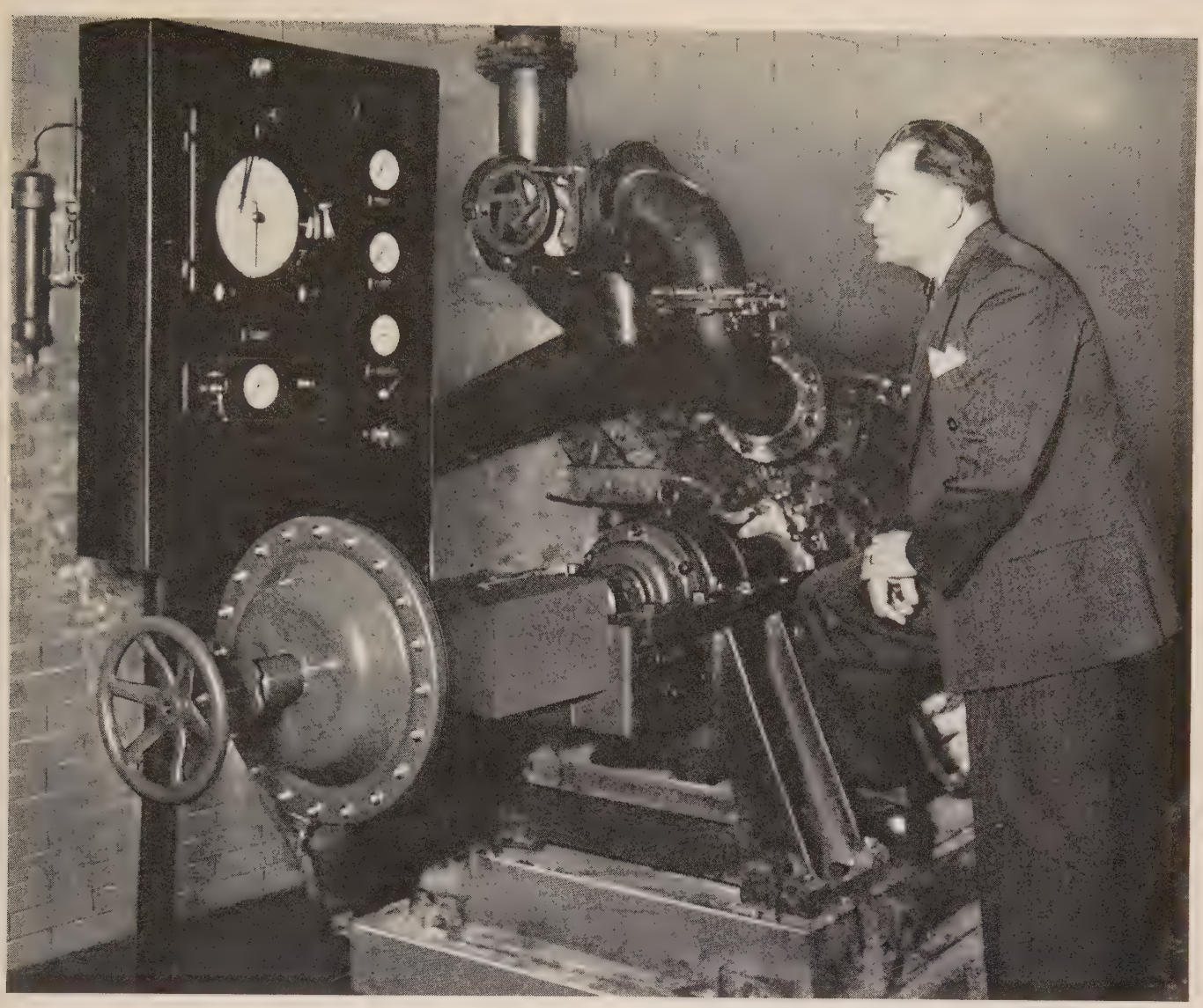

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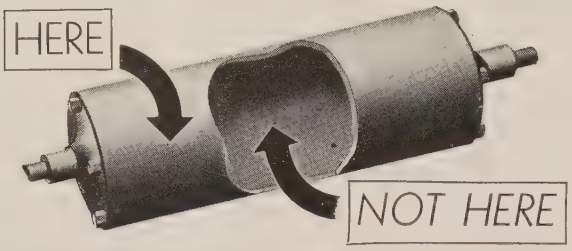

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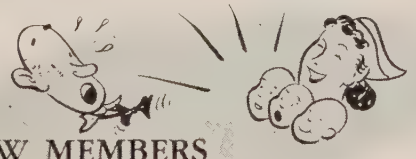

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(continued from page 56)

William J. Loney, Chemical Engineer, Canadian Industries Ltd., Montreal, P. Q., Canada, a 1939 graduate of Queen's University.

William D. Maxim, Division Manager, International Paper Co., New York City.

John E. Maxson, Sales Engineer, Stebbins Engineering & Manufacturing Co., Watertown, N. Y., a 1941 graduate of Rensselaer Polytechnic Institute.

Robert C. McCully, Plant Engineer, International Paper Co., Niagara Falls, N. Y., a 1916 graduate of McGill University.

John A. McDermott, Superintendent, St. Regis Paper Co., Tacoma, Wash.

George S. Meehan, Plant Superintendent, St. Regis Paper Co., Herrings, N. Y.

Harry C. Moore, Vice-President, Beloit Iron Works, Beloit, Wis., a 1935 graduate of Northwestern University.

Arthur L. Mottet, Research Engineer, Long-Bell Lumber Co., Longview, Wash., a 1937 graduate of the University of Washington.

Bjorn A. Nelson, Civil Engineer, Mo & Domsjo A/B, Ornskoldsvik, Sweden, a 1943 graduate of the Royal Technical University.

Edward C. Nelson, Chief Engineer, Gilbert Paper Co., Menasha, Wis., a 1926 graduate of Lawrence College.

James V. Otness, Products Control Officer, Minnesota & Ontario Paper Co., Minneapolis, Minn., a 1941 graduate of the University of Minnesota.

Clarence E. Oxford, Assistant to the President, C. M. Guest & Sons, Anderson, S. C., a 1928 graduate of Georgia School of Technology, with an M.S. degree from Yale University in 1929.

Leslie A. Palmer, Mill Manager, Donnacona Paper Co. Ltd., Donnacona, Que., Canada, a 1930 graduate of Montreal Technical Institute.

Miss Josefina Peraza, Chemist, Guest Worker at the National Bureau of Standards, Washington, D. C., from the National Bureau of Standards of Mexico, a 1945 graduate of the University of Yucatan.

K. Umanatha Rao, General Manager, The Mysore Paper Mills Ltd., Bhadravati, South India, a graduate of Madras College.

Ernest J. Reidman, Assistant Plant Superintendent, Keyes Fibre Co., Waterville, Me., a 1938 graduate of the University of Maine.

John Robert, Director of Engineering, Globe Roofing Products Co., Inc., Whiting, Ind., a 1914 graduate of Technical University, Vienna.

Augustus W. Rocker, Refiner Supervisor, Miami Paper Board Mills, Inc., Miami, Fla.

Sedgwick C. Rogers, Chemist, Kimberly-Clark Corp., Neenah, Wis., a 1941 graduate of the University of Minnesota and a Ph.D. degree from Pennsylvania State College in 1944.

Swanie S. Rossander, Assistant Director, Jackson Laboratory, E. I. du Pont de Nemours & Co., Wilmington, Del., a 1924 graduate of Tarkio College with a Ph.D. degree from the University of Illinois in 1930.

James O. Sanders, Chemist, Keith Paper Co., Turners Falls, Mass. Attended the University of Maine.

Frank M. Sanger, Chief Engineer, The Pusey & Jones Corp., Wilmington, Del., a 1909 graduate of Cornell University.

Maurice G. Scholten, Supervisor of Engineering and Maintenance, A. P. W. Products Co., Inc., Albany, N. Y., a 1928 graduate of the University of Illinois.

Alan G. Schumaker, Technical Director, McEwan Brothers, Whippany, N. J., a 1930 graduate of Dartmouth College.

Walter W. Schuster, Sales Representative Pulp Sales, Inc., New York City, a 1943 graduate of Northeastern University.

(continued on page 60)

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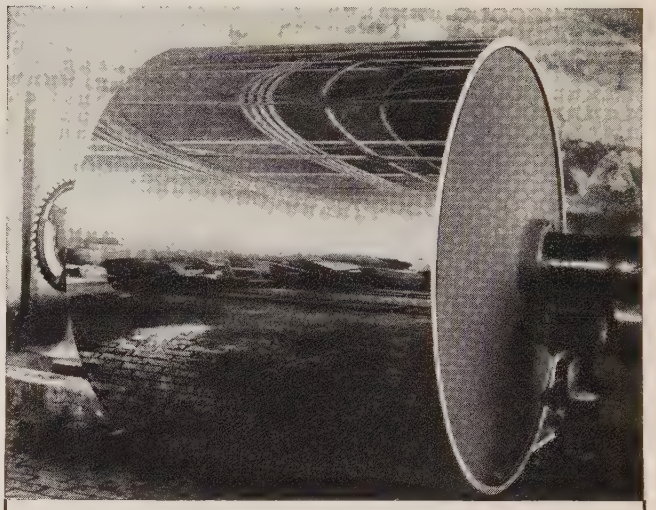

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Offices
NEW YORK, N. Y. CEDAR RAPIDS, IOWA

(continued from page 58)

Fred R. Sheldon, Research Chemist, Buffalo, Electro-Chemical Co., Buffalo, N. Y., a 1939 graduate of the Massachusetts Institute of Technology.

Paul Soderdahl, Chief Chemist, Hart & Harrington, Inc., Chicago, Ill., a 1932 graduate of the State University of Iowa.

Leonard F. Swec, Chief Chemist, H. P. Smith Paper Co., Chicago, Ill., a 1940 graduate of the University of Chicago.

Chester J. Schmidt, Vice-President and District Manager, J. O. Ross Engineering Corp., Detroit, Mich., a 1923 graduate of the University of Wisconsin.

Raymond J. Shillum, Sales Manager, Brown-Hutchinson Iron Works, Detroit, Mich.

Douglas W. Shook, Materials Laborer, Kimberly-Clark Corp., Neenah, Wis., a 1948 graduate of Yale University.

Sigurd Solvason, Construction Manager, C. M. Guest & Sons, Anderson, S. C. Attended Valparaiso University and the University of North Dakota.

Harold Spector, Chemical Engineer, Taggart Corporation, Watertown, N. Y., a 1944 graduate of the University of Saskatchewan.

Walter J. Sydor, Research Chemist, McLaurin-Jones Co., Brookfield, Mass., a 1940 graduate of Worcester Polytechnic Institute.

William Thomas, Research Director, W. Ralston & Co., Inc., Old Bridge, N. J., a 1938 graduate of Albright College.

Shang-Jen Tsou, Engineer, Chung Yuan Paper Co., Shanghai, China, a 1935 graduate of Harbin University, China, with an M.S. degree from the University of British Columbia in 1948.

William E. VanVoorhis, Student, University of Maine, Orono, Me.

Emil Venemark, Civil Engineer, Mo & Domsjo A/B, Husum, Sweden, a 1927 graduate of Chalmers Technical University.

Birger vonKramer, Paper Mill Manager, Mo & Domsjo A/B, Hornefors, Sweden, a 1933 graduate of the Technical University, Finland.

John E. Walsh, Jr., Salesman, Government Contract Officer and Director, Walker-Goulard-Plehm Co., New York City.

William Whiting, Jr., Student, University of Maine, Orono, Me.

Ado A. Zando, Assistant Chief Engineer, St. Regis Paper Co., Deferiet, N. Y., a 1934 graduate of Clarkson College.

Carl W. Ziegenbusch, Division Engineer, Mead Corp., Chillicothe, Ohio, a 1926 graduate of the University of Pennsylvania.

Milton Zucker, Research Manager, International Printing Ink Div., Interchemical Corp., New York City, a 1924 graduate of Case Institute of Technology.

TAPPI Directory Changes

William R. Adams, formerly general superintendent of the Taggart Corp., is now vice-president, St. Regis Paper Co., Deferiet, N. Y.

Donald Appleton is now vice-president in charge of manufacture, Oxford Paper Co., 230 Park Ave., New York, N. Y.

Wilmer J. Balster, formerly of the Q.M. Subsistence Research Laboratory, is now vice-president, Don L. Quinn Co., Chicago, Ill.

Seward M. Bazler of the Mead Corp. has been transferred from Chillicothe, Ohio, to Kingsport, Tenn.

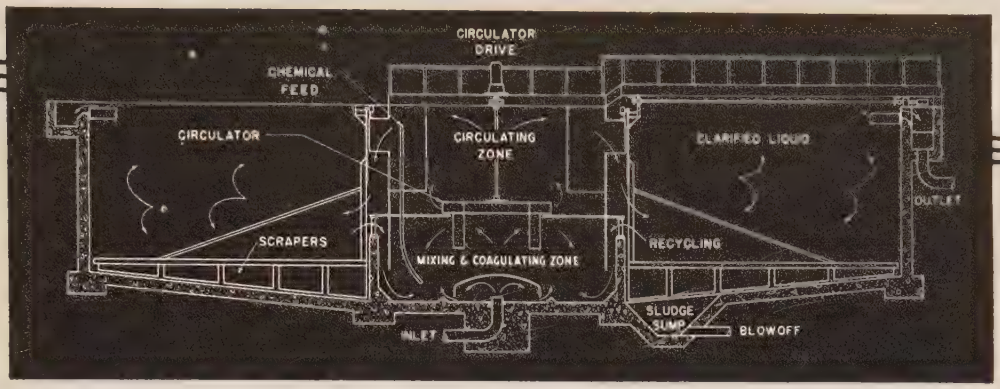
J. O. Boesinger is now pulp mill superintendent, Mead Corp., Harriman, Tenn.

Robert A. Baum, formerly of the Fernstrom Paper Mills is now with Bulkley, Dunton Pulp Co., Pasadena, Calif.

James D. Brown, formerly of Sprout, Waldron Co. is now sales engineer, Sutherland Refiner Corp., Trenton, N. J.

(continued on page 62)

NEW White Water Treatment



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(continued from page 60)

Frederick S. Crysler is now general manager, Paper Mill Div., Container Corp. of America, Manayunk, Pa.

Wallace A. Doepel is now sales manager, Lynch Corp., Toledo, Ohio.

L. C. Durant is now vice-president, Paper & Industrial Appliances, Inc., New York, N. Y.

Theodore P. Duver, formerly of the Crown Zellerbach Corp., is now research director, Dilts Machine Works, Fulton, N. Y.

J. C. W. Evans, formerly of the Sorg Paper Co., is now asst. editor, *Pulp and Paper Magazine of Canada,* Gardenvale, P. Q.

O. W. Frost is now with the Wood Fiber Products Co., Forest Grove, Ore.

Robert J. Harlow, formerly of the Univ. of Maine, is now in the development department, Robert Gair Co., Uncasville, Conn.

Raymond S. Hatch, formerly director of research, Weyerhaeuser Timber Co., is now engaged in consulting service on pulping, bleaching, and pulp purification at 14 Wall Ave., San Rafael, Calif.

Frank J. Hoffman III, formerly of the Miami Valley Coated Paper Co., is now with the Sorg Paper Co., Middletown, Ohio.

Arthur P. Hunneman is now a consulting engineer, 348 Palisade Road, Elizabeth, N. J.

Marvin C. Jones, formerly of the Michigan Carton Co., is now manager, sulphate pulp and container board mill, Weyerhaeuser Timber Co., Springfield, Ore.

Werner Kaufmann, vice-president, Kupfer Bros. Co., is now with the Kupfer Bros. Paper Co., 145 W. Hubbard St., Chicago, Ill.

Hugo Klein, formerly of Converted Rice, Inc., is now a consulting chemical engineer, 4415 Roseneath Drive, Houston 4, Tex. Mr. Klein specializes in blueprint, diazotype, tracing, and similar type papers.

W. B. Lincoln, Jr., is now technical manager, Inland Container Corp., Indianapolis, Ind.

Clark Marion, vice-president, Champion Paper & Fibre Co., has been transferred from San Francisco, Calif., to Dairypak, Inc., 5250 Brook Park Road, Cleveland, Ohio.

Arthur F. Martin is now manager of the cellulose plant, Hercules Powder Co., Hopewell, Va.

Melvin L. McCreary is now asst. mgr., West Virginia Pulp & Paper Co., Williamsburg, Pa.

Bryan C. McMahon, formerly of the Marathon Paper Mills of Canada is now technical superintendent, Canada Paper Co., Windsor Mills, P. Q.

Edwin C. Molin of the Glassine Paper Co., has been transferred from Manayunk, Pa., to W. Conshohocken, Pa.

Robert H. Mosher, formerly of the Marvellum Co., is now manager of manufacturing, Holyoke Card and Paper Co., Springfield, Mass.

Henry J. Perry, formerly of Frederic C. Clark Associates, has opened his own consulting office at 1 E. 42nd Street, New York, N. Y.

Jack B. Pohlenz, Dept. Chemical Engineering, M.I.T., has been transferred from the Bangor Practice Station to the Mass. Inst. of Technology, Cambridge, Mass.

Henry C. Press, formerly of the Oxford Paper Co., is now process engineer, Marathon Corp., Menasha, Wis.

Carl E. Price, formerly of the Scott Paper Co., is now with Ball Bros. Co., Noblesville, Ind.

T. Richard Probst, formerly of the Keith Paper Co., is now asst. to the mill manager, Oxford Paper Co., Rumford, Me.

Arthur H. Razee is now manager, chemical sales and service, Rumford Div., Heyden Chemical Corp., Rumford, R. I.

Robert W. Reed, formerly of the Ozalid Div., General Aniline & Film Co., is now supervisor of fundamental research, Rhinelander Paper Co., Rhinelander, Wis.

G. T. Renegar is now superintendent, Paper Mill Div., Container Corp. of America, Manayunk, Pa.

Edward T. Riley, formerly of the New York State College of Forestry, is now in the Research Div., International Paper Co., Glens Falls, N. Y.

B. K. Roecker, formerly of the Waterproof Ohio Paper Co., is now with the Pollock Paper Corp., Dallas, Tex.

L. J. Rys is now director general, Industrias Klabin do Parana de Celulose S. A., Parana, Brazil.

Wilfred W. Scheide is now general carton superintendent, American Coating Mills, 141 W. Jackson Blvd., Chicago, Ill.

Edgar L. Spruill, Jr., is now head of the research department, Southern Advance Bag & Paper Co., Hodge, La.

M. Bradley Stevenson, formerly of the Link Paper Co., is now salesman, Port Huron Sulphite and Paper Co., Chicago, Ill.

Harold F. Stose, formerly of Radio Inventions, Inc., is now head of the chemical engineering department, Sam Tour & Co., Inc., 44 Trinity Place, New York, N. Y.

John H. Symes, formerly of the Waterproof Ohio Paper Co., is now chemist, Excello Paper Products Co., Inc., Cincinnati, Ohio.

A. Szwarc, formerly of the Canada Paper Co., is now with the Arborite Co. Ltd., Montreal, P. Q.

R. Tourangeau, formerly of the Hopper Paper Co., is now general superintendent, W. C. Hamilton & Sons, Miquon, Pa.

Gabriel T. Turula, formerly of the New York State College of Forestry, is now chemist, American Coating Mills, Elkhart, Ind.

Peter Van Wyck, formerly of the Virginia Cellulose Div., is now asst. to the director of research, Hercules Powder Co., Wilmington, Del.

Victor M. Vidal is now chief chemist, Cia. Industrial de Atenquique S. A. Jalisco, Mexico.

John L. Waldo is now with the National Aniline Div., A.C.D.W., Boston, Mass.

Hermann F. J. Wenzl, formerly of Charlottenburg, Germany, is now general manager, Fedrigoni & Cie Paper Mills Ltd., Verona, Italy.

Rudolf Wettstein is now director, A/G fur Unternehmungen der Papier Industrie, St. Moritz, Zurich, Switzerland.

Ralph E. Westphal, chemical engineer, American Can Co., has been transferred from Maywood, Ill., to San Francisco, Calif.

C. W. Wilkins, chemist, National Container Co. of Michigan, is now with the National Container Corp., Jacksonville, Fla.

M. R. Wilkins, formerly of the Consolidated Machine Tool Co., is now technical supervisor, Kalamazoo Paper Co., Kalamazoo, Mich.

R. C. Williamson, is now vice-president, Alchem Ltd., Burlington, Ont.

A. John Winchester, formerly of Price Bros. & Co., is now with the Donnacona Paper Co., Donnacona, P. Q.

Victor J. Wirpsa, chemist, The Champion Paper & Fibre Co., has been transferred from Hamilton, Ohio to Pasadena, Tex.

Bruce H. Wright of the Crown Zellerbach Corp., has been transferred from Camas, Wash., to West Linn, Ore.

Following are changes made in official representation in TAPPI by company members:

N. R. Berman has succeeded W. W. Wheeler as official representative of the Askania Regulator Co., Chicago, Ill.

L. G. Wright, Biggs Boiler Works Co., Akron, Ohio, has succeeded B. R. Barder.

R. J. Lee, Lockport Felt Co., Newfane, N. Y., has succeeded L. D. Carner.

Kenneth D. Hay, Asten-Hill Mfg. Co., Philadelphia, Pa., has succeeded J. A. Roslund who will represent the Company on the Pacific Coast.

A. A. Nyitray, Eastwood-Nealley Corp., Belleville, N. J., has succeeded H. G. Specht.

Walter M. Bain, Soya Products Div., The Glidden Co., 5165 W. Moffat St., Chicago, Ill., has succeeded P. E. Sprague of Cleveland, Ohio.

F. E. Hutton, Babcock & Wilcox Co., New York, N. Y., has succeeded C. M. Neighbors.

Harold Bialowsky, Pulp Div., Weyerhaeuser Timber Co., has succeeded Howard W. Morgan.

Charles L. Neely, Plaskon Div., Libbey-Owens-Ford Glass Co., has succeeded W. N. Shepard.

The name of the Combustion Engineering Co., Inc., has been changed to Combustion Engineering Superheater, Inc., 200 Madison Ave., New York, N. Y.

The Pollock Paper & Box Co., Southern Waxed Paper Co., and Waterproof-Ohio Paper Co., will hereafter be known as the Pollock Paper Corp.

Charles G. Weber

Charles G. Weber, Asst. Chief of the Paper Section, National Bureau of Standards, Washington, D. C., died of a heart attack in Washington on January 18. Mr. Weber was born in South Wales, N. Y., on October 12, 1893, and was a member of the first pulp and paper course class (1916) of the New York State College of Forestry, Syracuse, N. Y.

From 1919 to 1922 he was employed by the Beaver Board Co., Anderson, Ind. In 1923 he worked for Sweet Bros. Mfg. Co., Phoenix, N. Y., and from 1923 to 1928 he was forester for the Burlington Basket Co., Burlington, Iowa. He joined the staff of the Bureau of Standards as a technologist in 1928.

Mr. Weber was an active participant in the committee activities of the Technical Association and the Am. Soc. for Testing Materials. Funeral services were held at Allbrook Methodist Church, Washington, D. C., on Friday, January 21. Interment was in Arlington Cemetery.

F. W. Vickery

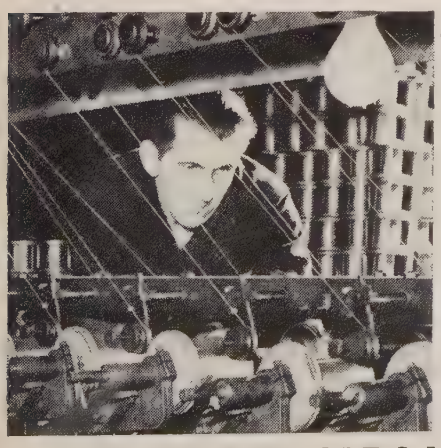
On January 11, F. W. Vickery of Vickery's Ltd., London, passed away at his home in Guildford, Surrey, England.

Mr. Vickery's entire career was closely associated with the paper industry. He contributed in many ways to the progress of the industry through the conception, development, and construction of a number of important items of paper mill equipment, among the best known of which are the Vickery felt conditioner, the Vickery doctor, and the Dirtec.

William G. MacNaughton

On February 5, William G. MacNaughton, former Secretary-Treasurer of the Technical Association died at Yonkers, N. Y.

Mr. MacNaughton's obituary will be published in the March issue of *Tappi*.



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ASSOCIATION NEWS AND EVENTS

Hardy S. Ferguson Awarded TAPPI Medal

H. S. Ferguson

The seventeenth TAPPI Medal has been awarded to Hardy S. Ferguson, consulting engineer and architect, New York City. Mr. Ferguson was born in 1868 and graduated from Dartmouth College and in 1891 from the Thayer School of Civil Engineering, connected with Dartmouth College. He has been in engineering practice since 1891, connected with the design and construction of pulp and paper mills, and of water power developments and hydroelectric power plants.

One of his first big jobs was the building of the Great Northern Paper Mill at Millinocket, Me., completed in 1899. It was here that he developed the first continuous drum barker that was used in the United States. He has been closely connected with the development of the paper machine, particularly respecting speed increases from 300 to 1500 f.p.m. Once only has he ever patented any of his ideas, and in this case contributed it to the improvement of the art.

In addition to the mill of the Great Northern Paper Company he has designed mills for the Brown Company, Union Bag & Paper Corporation, Jonquiere Pulp Company, Hollingsworth & Whitney Company, St. Lawrence Pulp & Lumber Company, Penobscot Chemical Fibre Company, Bedford Pulp & Paper Company, St. Maurice Paper Company, Oxford Paper Company, Ha Ha Bay Sulphite Company, Fraser Companies, Riordan Pulp & Paper Company, Gilman Paper Company, Cushnoc Paper Company, Brompton Pulp & Paper Company, Backus-Brooks Company, Bathurst Company, Beaver Wood & Fibre Company, Chicago Mill & Lumber Company, James Maclaren Company, Soundview Pulp Company, Crossett Paper Mills, and others, not including many miscellaneous engineering project connected with power developments and mill improvements and extensions.

TAPPI Coating Conference

In the fall of 1948 the Association conducted six regional conferences on a national basis. In 1949, in addition to the general fall meeting at Poland and the Fourth Engineering Conference of the Pulp and Paper Industry to be held in Boston in November, there will be a national conference sponsored by the Coating Committee on April 26–27, 1949, at the Pantlind Hotel, Grand Rapids, Mich. A strong technical program is being prepared under the joint chairmanship of W. A. Kirkpatrick, Allied Paper Mills, Kalamazoo, Mich., and Peter J. Massey, St. Regis Paper Co., New York, N. Y. The general arrangements, mill visits, entertainment, etc., is being handled by the Kalamazoo Valley Section, Paul W. Bartholomew, Hawthorne Paper Co., chairman. About 300 are expected to attend from all parts of the Country. The final program will be published in March *Tappi*.

Inter-Society Color Council Meeting

The 17th annual meeting of the Inter-Society Color Council will be held on Wednesday, March 9, 1949, at the Hotel Statler, New York City. The following committees will report: Revision of Color Names, Color Terms, Color Specifications, Studies of Illuminating and Viewing Conditions in the Colorimetry of Reflecting Materials, Study of Transparent Standards Using Single-Number Specification. The Technical Association is a member of the Council. Any member of TAPPI who is interested in color technology is welcome to attend this meeting and the meeting of the Optical Society of America on March 10 to 12.

Fall Meeting at Portland, Ore.

Preliminary plans for a general fall meeting of the Technical Association are under way. This meeting, the first national meeting to be held on the Coast since 1940 will be held in Portland, Ore., with headquarters at the Multnomah Hotel. A. G. Natwick, Crown Zellerbach Corp., Camas, Wash., and R. J. Le Roux, Pulp Div., Weyerhaeuser Timber Co., are the co-chairmen.

The general plan of the meeting is expected to be as follows: Sunday, September 11—Arrival and registration at the Multnomah; Monday, September 12—Woods trip (men and women); Tuesday, September 13—Golf, mill visits (men), and special program for women; Wednesday, September 14—Technical program (men) and visit to Mt. Hood (women); Thursday, September 15—Technical program and banquet. Further details will be reported at the annual meetings and during the coming months. The important thing now is to fix the dates in mind and plan to attend.

Technical Association Papers—31

The 31st Series of Technical Association Papers have been distributed to the membership of the Association. This 822-page cloth-bound volume is the final volume of the series, which started in 1918, to be published. The publication of the new magazine *Tappi* has made further publication of Technical Association Papers unnecessary. Until the present year the Association published many of its papers in the *Paper Trade Journal*. These papers together with other articles and discussions, constituted the text of the bound volume.

The New TAPPI Officers

In the mail ballot, recently completed, the following Association Officers and Executive Committeemen were elected:

Albert E. Bachmann

Kenneth P. Geohegan

Albert E. Bachmann, Vice-President, The Missisquoi Corp., Sheldon Springs, Vt., was elected President. Al was born in Boston, Mass., in 1899, and graduated as a chemical engineer in 1921 from the Massachusetts Institute of Technology. His first job in the industry was with the Pejepscot Paper Co., Lisbon Falls, Me., where he was a tester. Following this he was employed by the American Writing Paper Corp., Mt. Holly Paper Co., Kimberly-Clark Corp., and eventually the Missisquoi Corp. Aside from formerly being a better than average baseball player he is not too bad at golf.

Kenneth P. Geohegan, Vice-President, The Howard Paper Mills, Inc., Dayton, Ohio, was elected Vice-President. Ken was born in Cincinnati, Ohio, in 1893 and graduated from the University of Cincinnati as a chemist in 1915. In 1924 he received his M.S. from Cornell University. Prior to joining the Aetna Paper Company, now a Division of the Howard Paper Mills, Inc., in 1925, Mr. Geohegan had a varied and profitable experience as a chemist for Procter & Gamble, American Oak Leather Co., U. S. Army Ordnance Dept., Roessler & Hasslacher, Richardson Co., and the Georgia School of Technology. Mr. Geohegan has long been active in TAPPI committee work and the Ohio Section. For the past few years, as chairman of the Local Sections Committee he did much to encourage these groups and to systematize the relations between the sections and the national organization. He has also been of great assistance to the Rag Content Paper Manufacturers Association.

Four Executive Committeemen were elected to serve a three-year term, and one, Karl O. Elderkin, to serve a one-year term, made vacant by Mr. Geohegan's advancement.

James d'A. Clark, who has been a member of the Committee was re-elected. Dr. Clark is a consultant in pulp and paper technology, at present located in Longview, Wash. He was born in Ayrshire, Scotland, in 1901, and graduated from the University of London in 1922 in mechanical engineering. In England he worked for such companies as Mavis Engineering Co., Hendon Paper Works, Edw. Lloyd, Ltd., and the Bowaters Paper Mills. He devoted a year to the study of pulp and paper manufacture under a fellowship of the London County Council, devoting considerable time to studying the operations of the Canada Paper Co. Coming to the United States about 1928 he was employed by the Mead Corp. and the Scott Paper Co., following which he attended the Institute of Paper Chemistry where he received his Ph.D. During the recent war Lt. Col. Clark did an epic job for the Quartermaster Corps. in establishing packaging materials specifications. Everyone knows of the tremendous effort that he has given to the work of the Technical Association as chairman of its Testing Division.

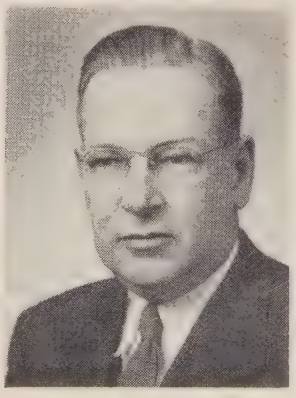
Martin L. Downs, Chief Chemist, Thilmany Pulp and Paper Co., Kaukauna, Wis., is a newcomer to the Executive Committee. He was born in Reading, Pa., in 1910 and graduated from Pennsylvania State College in 1931 as a chemical engineer. In 1934 he received his Ph.D. from the Institute of Paper Chemistry, following which he was engaged in development work for the Mead Corp. In 1937 he joined the Thilmany organization. He was a chairman of the Lake States Section and in addition to participating in TAPPI committee work has been active in the technical committee work of the Glassine and Greaseproof Mfgrs. Assoc., the Waterproof Paper Mfgrs. Assoc., and the National Council for Stream Improvement.

Werner Kaufmann was re-elected to the Committee. He is Vice-President of Kupfer Bros. Paper Co., coated paper manufacturers, Chicago, Ill. He was born in New York City in 1905 and received his doctorate in chemical engineering from the Swiss Federal Institute of Technology in 1931. As chairman of the Coating Committee, Dr. Kaufmann has rendered great service to the members of the Technical Association, particularly in promoting the preparation and publication of the Association monographs on Resins, Starch, and Pigments for Paper Coating, as well as the others in process. He has aided greatly the New England Section as the representative of the National Executive Committee.

George H. Pringle, Asst. Chief Engineer, Mead Corp., Chillicothe, Ohio, will be serving his first term on the Executive Committee. George was born in Pictou, N. S., in 1903, and graduated in 1926 from McGill University as a mechanical engineer. Following a brief period as junior engineer for the Canada Paper Co., he joined the engineering staff of the Mead Corp. Following the War when the Association reorganized its Engineering Division he became chairman of the new Mill Maintenance and

James d'A. Clark

Werner Kaufmann



George H. Pringle

Karl O. Elderkin

Materials Committee and has been a prime mover in establishing the Engineering Conference at its present high standard of excellence. As a member of the Executive Committee, Mr. Pringle will be general chairman of the Engineering Division of the Association.

Karl O. Elderkin, Manager, Crosett Paper Mills, Crossett, Ark., is also a newcomer to the Committee. He was born in Weymouth, N. S., in 1895 and graduated from McGill University in 1920 as a mechanical engineer. Following a few years in the steel industry he entered the paper industry as a draftsman at the St. Lawrence Paper Mills in 1922. From 1923 to 1925 he was chief draftsman for Price Bros. Co. Ltd., and from 1925 to 1928 was asst. chief engineer for the Abitibi Power & Paper Co. In 1928–29 he was chief engineer for the Mersey Paper Co. From 1929 to 1936, engineer and general manager of the Cornerbrook, Nfld., mill of the International Paper Co. From 1937 to 1939 he was associated with John Stadler in Montreal as an engineering consultant and joined Crossett in 1939. Mr. Elderkin is a member of the Executive Committee of the Kraft Paper Assoc., and has helped TAPPI greatly through his encouragement and support of Ken Chesley of his Company as chairman of the Alkaline Pulping Committee.

Members of the Executive Committee whose terms continue are: J. D. Davis, A. C. Hill, R. A. Wilkins, H. W. Bialkowsky, F. C. Goodwill, W. B. Lincoln, Jr., and A. L. Sherwood.

Structural Fibrous Materials Committee

JOHN F. CAMPBELL

The Structural Fibrous Materials Committee of the Technical Association was organized at the annual meeting in 1946. This committee was organized as the result of protests by a number of men in the insulating wall board industry who complained that the Association had little to offer technical men outside the realm of pulp and paper manufacture. The personnel of the committee has grown until at the present time every major producer of insulating wall board is represented on the main committee and each of its two subcommittees.

It was early recognized that it was going to be extremely difficult for representatives of the various mills to intelligently discuss things of mutual interest. The primary difficulty arose out of a diversity of test methods being employed by the various mills. Whereas kraft is essentially kraft and sulphite invariably sulphite, insulating board is made from as many raw materials and by as many processes as there are companies engaged in its manufacture. Each mill had developed its own system of test methods adapted to its particular process. Freeness, for example, was being measured by several different kinds of testers, none of which were standard in either construction or sample size. Other test methods also varied from one mill to the other.

In order that the same language could be spoken by all members of the committee, it was agreed that a standardization of test methods must be obtained. Early in 1946, two subcommittees were organized for the purpose of developing and standardizing test methods for insulating board raw materials and finished products. The task remains far from completion, at the present time, but considerable progress has been made.

Mr. E. M. Jenkins, of Johns-Manville Corporation, chairman of the Raw Materials Testing Subcommittee, has a program well under way which promises to be extremely beneficial to the industry. A survey was made and, as a result, a program was carried on at the Forest Products Laboratory under the direction of Mr. C. E. Hrubesky for developing a method for freeness testing which would be applicable to all pulps used in the manufacture of insulating wall board. Quantities of pulps were supplied to the Laboratory by seven manufacturers. These pulps were tested on several more or less standard devices and under a number of conditions. This study revealed that none of the existing instruments was applicable to the entire industry.

Other tests being investigated by Mr. Jenkins's subcommittee include test board forming, consistency measurement and fiber classification. It appears that this work will be considerably advanced by the time of the next annual meeting of TAPPI.

The Finished Products Testing Subcommittee, Mr. G. Basil Brown of Johns-Manville, chairman, has as his objective the selection or development, if necessary, of test methods on insulating board finished products which will be universally acceptable throughout the industry. In this work an effort is being made to adopt possible existing methods which have received acceptance by other organizations such as ASTM, The Insulation Board Institute, and Bureau of Standards. Methods for evaluating a large number of properties are under consideration, and it appears that considerable time will be required in order to cover the entire field and settle all controversial issues which are certain to arise.

The Structural Fibrous Materials Committee met with the Testing Division in Pittsburgh on October 11 through 13. There was not sufficient representation of committeemen to take definite action on the methods discussed, but there was a good attendance at the meetings and the discussions resulted in considerable advancement of the program.

The insulating wall board industry is in its infancy. The Structural Fibrous Materials Committee of TAPPI is even younger. The technical men of the industry, recognizing its potentialities, are playing a large part in making it possible to compete with other types of well-established building materials. The Committee welcomes and solicits comments and suggestions.

JOHN F. CAMPBELL, Chairman, TAPPI Structural Fibrous Materials Committee, Development and Research Chemist, The Flintkote Company, Meridian, Miss.

Committee Chairmanship Changes

Henry Vranian, Chesapeake Corp. of Virginia, West Point, Va., will succeed K. G. Chesley, Crossett Lumber Co., Crossett, Ark., at the annual meeting, as chairman of the Alkaline Pulping Committee.

Linton E. Simerl, Marathon Corp., Menasha, Wis., has succeeded George E. Sears, Institute of Paper Chemistry, Appleton, Wis., as chairman of the Packaging Materials Testing Committee.

Wilmer J. Balster, Don L. Quinn Co., Chicago, Ill., has succeeded Don L. Quinn as chairman of the Container Testing Committee.

Alvin H. Johnson, consulting engineer, New York, N. Y., has succeeded Milton Jacobs, Chas. T. Main, Inc., Boston, Mass., as chairman of the Mill Design and Economic Aspects Committee.

Miss Louise E. McGrath, Booth Chemical Co., Elizabeth, N. J., is acting chairman of the Water Committee, temporarily replacing Lewis B. Miller, University of Cincinnati.

Joseph J. Thomas, S. D. Warren Co., Cumberland Mills, Me., has succeeded P. P. Gooding, Strathmore Paper Co., W. Springfield, Mass., as chairman of the Preparation of Papermaking Materials Committee.

James J. Harrison, Michigan Carton Co., Battle Creek, Mich., has succeeded O. E. S. Hedbring, United Board & Carton Co., Thompson, N. Y., as chairman of the Paper Making (Cylinder) Committee.

Stephen I. Kukolich, Lee Paper Co., Vicksburg, Mich., has succeeded W. F. Hathaway, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich., as chairman of the Nonfibrous Materials Testing Committee.

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Calendar of TAPPI Meetings

NATIONAL

Annual Meeting, Commodore Hotel, New York, N. Y., February 21–24, 1949.

Paper Coating Conference, Pantlind Hotel, Grand Rapids, Mich., April 25–28, 1949.

General Fall Meeting, Multnomah Hotel, Portland, Ore., September 11–15, 1949.

Fourth Engineering Conference of the Pulp and Paper Industry, Statler Hotel, Boston, Mass., October 31, November 1–3, 1949.

LOCAL SECTIONS

CHICAGO SECTION: Chicago Bar Association, Chicago, Ill.
March 21, 1949; April 18, 1949.

DELAWARE VALLEY SECTION: Engineers Club, Philadelphia, Pa.
March 24, 1949—"Recent Progress in Cellulose Research," by Herman Mark, Polytechnic Institute of Brooklyn.
April 28, 1949—Testing Methods—A Panel Discussion, R. J. Knoll, Scott Paper Co., Moderator.
May 26, 1949—"Long Range View of the Pulp Supply," by James L. Ritchie, U. S. Pulp Producers Association.

EMPIRE STATE SECTION:
Western New York Group: April 13, 1949, at Erie, Pa., sponsored by the Hammermill Paper Co. Tour of mill, followed by dinner meeting.
Metropolitan Group: Fraunces Tavern, New York City.
Meetings on first Tuesday of month.

KALAMAZOO VALLEY SECTION: Park American and Columbia Hotels, Kalamazoo, Mich.
Meetings on second Tuesday of month.

LAKE STATES SECTION: American Legion Club House, Appleton, Wis.
March 8, 1949—Stock Preparation
April 12, 1949—Marathon's Canadian Operations

NEW ENGLAND SECTION:
Meetings usually held on the third Friday each month, usually at the Roger Smith Hotel, Holyoke, Mass., unless otherwise announced.

OHIO SECTION: Manchester Hotel, Middletown, Ohio
February 15, 1949—"Calender Finishes"
March 10, 1949—"Paper Coating"

PACIFIC SECTION:
April 8, 1949, Longview, Wash.—Shibley Award Contest

Paper and Packaging Specifications

FEDERAL SPECIFICATIONS

UU-L-49 (Amend. 1, Sept. 23, 1948) Labels; Paper, Gummed
UU-P-147 (Amend. 1, Aug. 24, 1948) Paper; Building, Waterproofed
UU-P-536 (Cancellation, July 21, 1948) Paper; Sheathing, Waterproofed (superseded by UU-P-147)
UU-T-81c (July 26, 1948) Tags; Shipping and Stock

Note: During World War II circular stock tags without metal binding, composed of vulcanized fiber, were substituted for the metal-bound tags made of chemical wood fiber, for the conservation of metal. After the War, the former type of tags was deleted and the wood fiber tags have now been restored. The vulcanized fiber tags have now been restored to the specification as it is found that they are still being made in considerable amount. The requirements for the wires and strings have been revised upward to secure better quality.

UU-T-123 (July 21, 1948) Tape, Photographic; Paper, Pressure-Sensitive

Note: This tape is intended for such uses as edging and block-out purposes in the development and printing of negatives and for use in sealing cans of photographic film.

UU-T-591a (Aug. 5, 1948) Towels; Paper

Note: This revision was developed jointly by the National Bureau of Standards and a technical committee of the Tissue Association, Inc. It has the approval of the Association. Test data for the revision were obtained at the Bureau on 19 samples representing the products of 13 manufacturers. Three types are now specified instead of two. The new type is treated for high wet strength, the others, not so treated, differing from each other in absorptiveness and strength. In addition to requirements for these properties, the wet-strength type requirements include wet tensile strength and total absorption of water. The test method for the latter was developed at the Bureau. Roll towels were eliminated as they are no longer used by the Government. Three kinds of folds are specified, singlefold, multifold, and C-fold, with different sizes for each kind of fold, in accordance with conventional practice.

U. S. ARMY SPECIFICATIONS

CQD-78C (Amend. 1, Oct. 22, 1948) Apples; Dehydrated
CQD-402 (Amend. 2, Aug. 11, 1948) Rice; Parboiled
CQD-404 (Oct. 12, 1948) Food Packet; Individual, Assault, IA-1

EMPLOYMENT SERVICE

As a service to the pulp and paper and allied industries *Tappi* will make available in this column a listing, without charge, of positions open and positions wanted.

Companies desiring to obtain the services of mill operating executives, chemists, engineers, superintendents, etc., and, in the case of the allied industries, salesmen and service engineers may submit copy similar to that used in the trade papers.

Men seeking employment may prepare their own brief statement of qualifications and the type of job wanted.

The service will be conducted on a confidential basis unless the Association Secretary is instructed to act otherwise. All printed notices will have a coded box number and letters will be forwarded to the company or individual.

The Technical Association has performed this service to its members and the industry since its earliest days and has been a direct aid in assisting hundreds of individuals attain employment. The insertion notice will appear in but one issue unless the Secretary is instructed to repeat it in additional issues.

The Secretary has a few job opportunities on file but these will not be published in this magazine unless the companies making the inquiries repeat their request.

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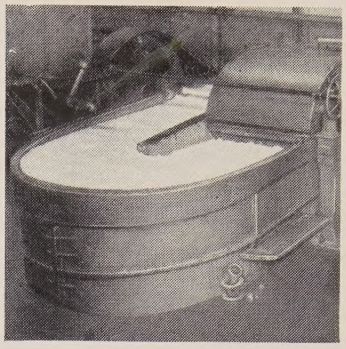

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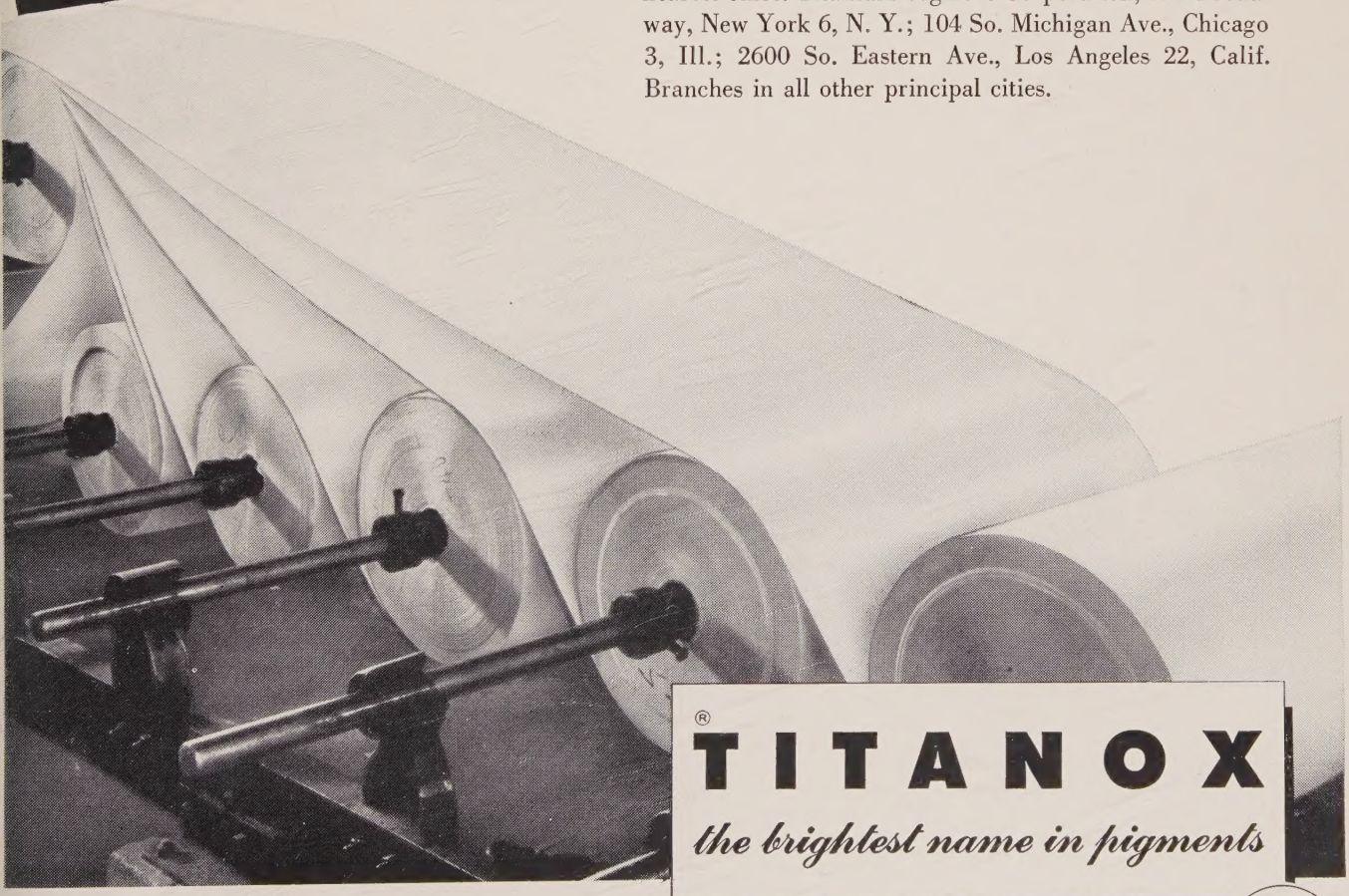

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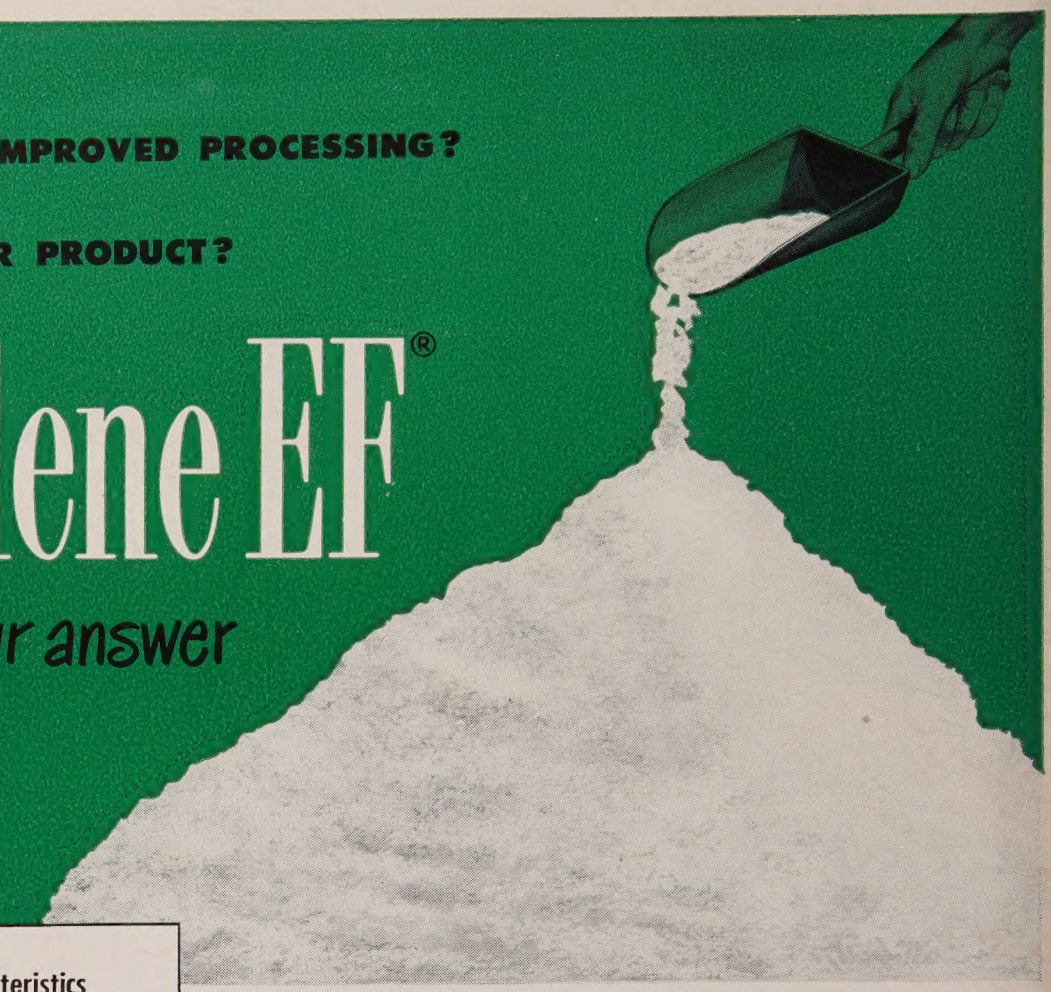

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